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Plans and specifications have been prepared by Mr. Theodore Cooper, M. Am. Soc. C. E., for a stiffened suspension bridge across the Hudson River for the New York & New Jersey Bridge Co. The plans call for a location between 59th and 69th Sts., New York city, with a clear span of 3,100 ft., and clear headway of not less than 150 ft. It will be a steel wire suspension bridge, stiffened by a longitudinal girder between the towers; with the approaches carried on viaducts, independent of the cables; the towers to be founded on rock and built of masonry to a point about 50 ft. above high-water and then topped with skeleton steel towers. The full specifications, elsewhere printed, give the further details. The bridge must not cost more than $23,000,000, and the time of erecting is placed at four years. Upon these conditions, bids are invited, with the privilege of changing details, so long as all changes conform to the specified requirements of loads and stresses.

The contract has been signed for the erection of a ten-story office building in Buffalo, N. Y., which will cost about $1,825,000; and with the land it is to occupy, $3,350,000. This building will be located on Ellicott Square, covering an area of 241 × 200 ft., and having a total height of 143 ft. Including the large inner court and the space under the sidewalks, the total volume of the structure will be 6,236,340 cu. ft., and the architects' estimate of completed cost is 26 cts. per cubic foot; or, $1,621,448.40. To this must be added about $83,500, for architects' fees, and the interest during building and taxes, which will bring the cost of the finished building up to the sum named above. D. H. Burnham & Co., of Chicago, Ill., are the architects, and F. W. Clark, of Chicago, is to be the builder. The Ellicott Square Co., of Buffalo, N. Y., has been incorporated at Albany with a capital of $1,400,000 in 1,400 shares. The directors named are William Hengerer, W. H. Hotchkiss, F. C. M. Lautz, T. T. Ramsdell, I. P. Dudley, G. P. Sawyer, J. N. Scatchard, George Urban, Jr., J. L. Williams, and H. W. Sprague, all of Buffalo, and Robert Winsor, of Boston, Mass.

The Jersey City water supply specifications, abstracted and discussed in our issues of Jan. 24 and 31, and Feb. 7, have been amended in a number of important particulars, and are being again published in full in the "News" and the "Journal" of Jersey City, prior to the actual request for proposals. March 25 is the date fixed for receiving bids, but this is subject to amendment. The principal changes in the specifications are: Material reductions in the bonds required from the successful bidder. The change of the standard of purity for both natural and filtered water from an absolute to a comparative standard, the bidders to submit their own standards of purity, and the standard of the successful bidder to be binding upon him. Arbitration as to the price to be paid by the city in case the contractor at any time furnishes water below his standard, instead of non-payment for any such water; minor changes removing some of the restrictions imposed by the specifications. The same standard of purity for natural and filtered supplies is still retained, but as the standards are only comparative this may result in no injury to any one, further than to reflect upon the lack of information and discrimination on the part of those responsible for the specifications.

The most serious railway accident of the week, with the exception of the Mexican accident noted below, was a collision on the Central R. R. of New Jersey at Pamrapo, N. J., March 1. The road has four tracks at this point. A southbound coal train broke in two, and the engineman was flagged at a signal tower, with the result that the rear part struck the front part with such force that some of the cars were derailed and fouled the adjoining track right in front of a southbound Blue Line express train. The engine of this train struck the cars, left the track, and, after running some distance, rolled over on its side. The baggage car mounted the tender and fell on the engine; the front end of the smoking car mounted the tender, and the day car and sleeping car were both derailed. The engineman and one of the two firemen on the express were killed, and three persons were injured. The wreck caught fire, but the flames were extinguished by the Bayonne fire department. The accident was somewhat similar to that on the New York Central R. R., recorded in our issue of Feb. 21.

A terrible derailment accident occurred on the Interoceanic Ry., near Tenango, Mexico, Feb. 28. The train was carrying a large number of pilgrims to the Catholic shrine of Sacre Monte, and is said to have been running at high speed on a dangerous part of the line, where the enginemen are instructed to slow down. At a sharp curve in the track the engine left the rails and went down a steep precipice, followed by three crowded cars; two more cars were derailed, but the others remained on the track. It is said that about 100 persons were killed and 60 injured.

The derailment of a fast train on the Louisville & Nashville R. R. near Greenville, Ala., on Feb. 23, which was reported in our issue of Feb. 28, is described as follows by a correspondent: The train was running at the rate of about 40 or 45 miles per hour, when, from some unknown cause, the front wheel of the tender mounted the rail about 8 ft. south of a perfect joint, the flange of the wheel cutting a small groove about the center of the rail, following the rail, to within 2 ft. of the next joint, when it went off the rail, cutting three of the bolts off at the joint. The trucks were slewed, but the tender continued to run along the ties until it reached a small trestle 40 ft. long, about 30 ft. from where it left the track. Here the outer wheels of the truck went off the bridge, causing the axles of the tender trucks to catch on the bridge, and bunch the ties of the bridge, making an obstruction which pulled the trucks from under the tender, and derailed three coaches. Where the wheels of the tender left the rails, the track was in perfect gage, and no cause for the accident could be ascertained, unless a piece of iron dropped on the track, causing the wheel to mount. The track was in perfect condition. All of the cars, with the exception of the tender, stayed on the track, until they reached the small bridge, when they were thrown off by the obstruction of ties on the bridge and the piled-up trucks.

Electric railway accidents continue to occur frequently in Brooklyn, N. Y. On a single day recently (March 1) there were three persons killed and five injured. The accidents are due to the excessive speed at which the cars are run, and steps are now being taken to check this reckless method of operation.

An explosion of gas occurred in the White Ash coal mine of the Atchison, Topeka & Sante Fe R. R., near Cerrillos, N. M., Feb. 27, causing the death of 39 men. The mine is said to have been poorly ventilated.

A switchman on the Sixth Ave. line of the New York Elevated R. R. caused a wreck at Worth St. March 1, by turning a switch while a down train was passing it. The rear truck of the last car took the switch and was struck by a switch engine. The car was derailed and had its side partly smashed in, four or five persons being slightly injured by falling glass and splinters.

Two buildings fell in New York on March 1. The walls of an airshaft in the middle of a row of four flat houses being built on Orchard St., between Rivington and Stanton Sts., gave way and the buildings were partially wrecked. Two men were killed and nine injured. The superintendent of buildings reported that the work was bad and the materials of poor quality.—The other building was an old malthouse at 10th Ave. and 43d St., which was being pulled down when the rear wall fell, killing three men and injuring several more.

A serious fire occurred in Toronto, Ont., on March 3 (the third which has visited the city within a short time), involving a loss of about $1,200,000. The city is said to have only one steam fire engine and the pressure of the hydrants was insufficient to throw a stream of water to the upper floors of the seven-story building in which the fire started.

A boiler explosion occurred Feb. 4 in the McLaughlin aerated water factory, at Toronto, Ont. The front wall was blown out, and the entire building collapsed.

A small trestle on the Chicago & Northwestern Ry., near Spring Valley, Ill., gave way under a freight train Feb. 26, and the engine and eight box cars went down, but the crew escaped.

Ice gorges in the Allegheny and Monongahela rivers are causing floods near Pittsburg, and bridges and buildings are in danger should the ice move suddenly.

Fatalities caused by electric railways in Brooklyn, N. Y., which now exceed 100 in number, have been investigated by the grand jury. As a result, the recommendation is made that immediate steps be taken to check the excessive rates of speed at which the cars are ordinarily run, proposing 8 and 12 miles per hour as the limits for the densely populated and outlying districts, respectively. A speed register in each car is also recommended. Fenders should be used, but their use should not be considered as freeing the companies from liability in case of accident. The mayor has visited Baltimore to inspect the fenders in use on the street cars of that city, and finds them much superior to those in use in Brooklyn.

The Harlem ship canal will soon be ready for navigation. The tug "Lillian M. Hardy" passed through on Feb. 27. It will have a depth of 9 ft. of water, which is to be increased to 12 ft., and will afford a direct route for canal boats, etc., from the East River to points in the Hudson River, avoiding the present route round the Battery and up the crowded lower part of the Hudson.

The drawspan of the New York, New Haven & Hartford R. R. bridge over the Thames River at New London, Conn., is said to have moved endwise toward the east, about 8 ins., and means are now being devised for returning it to its proper position.

Work is to be resumed at once on the eastern end of the Hennepin canal, and it is said that the first six locks will be completed by July, and the main channel completed to Tiskilwa, 9 miles from the Illinois River, by August. It has been decided to lower the summit level 7 ft., thus eliminating two of the locks and improving the feeder service.

The surveys for the Lake Erie & Ohio River ship canal have been commenced, and three parties are now at work. The first party, under W. C. Mobely, will proceed to the Mahoning River and survey up to Warren. The second party, under J. C. Oliphant, will begin its work at Warren and survey over the divide up to Conneaut Lake. The third party, under John A. Garber, will proceed to Conneaut Lake, and survey westward along the main feeders to develop the summit's capabilities and ascertain the elevations of the intermediate divides. When this work is completed all three parties will join and work down from the Mahoning River to the harbor at Pittsburg, completing the survey.

The awards have been made for the plans of the Minnesota Capitol building at St. Paul. About 56 plans were submitted, of which 20 were thrown out on account of the excessive cost of the structure proposed. The five prizes were awarded to Wendell & Humphreys, of Denver, Colo.; J. A. Schweinfurth, of Boston, Mass.; George R. Mann, of St. Louis, Mo.; George de Gersdorff, of New York, and Warren B. Dunnell, of Minneapolis. The first-named will get a commission on the work, the estimated cost being $1,500,000, and the other four receive $500 each.

A "local option" road law now before the Missouri legislature provides for the organization of special road districts of territory not more than six miles square, in which is located a city of the third or fourth class. The mayor, city council and county court of such a district are to appoint three commissioners to serve one, two and three years, respectively, and one commissioner to serve for three years is to be appointed each year; this board of commissioners to serve without compensation, except that actual necessary expenses will be repaid. The board will acquire all tools and machinery on hand for working roads in the district, and will have sole control over all public highways within its district outside the corporate limits of any city or village therein, and must employ men and machinery to do the road work, or let such work by contract. It may repair bridges and build new bridges whose cost does not exceed $100, more expensive bridges being built and repairs made at the expense of the county. One-fourth of all the receipts for dramshop, pool and billiard-table licenses collected by any city within the district are to be set apart for the road improvement by the board. For the road fund a poll tax of $2.50 is to be levied on every male inhabitant between 21 and 60 years of age living outside corporate limits, and a property road tax not to exceed 20 cts. per $100 valuation on real and personal property.

THE LIFT BRIDGE OF THE SIXTEENTH ST. VIADUCT, MILWAUKEE, WIS.

By John Geist, Chief Engineer, Wisconsin Bridge & Iron Co.

(With Inset.)

The Sixteenth St. Viaduct, recently completed at Milwaukee, Wis., is a structure 60 ft. wide and 4,000 ft. long, connecting two densely-populated portions of the city of Milwaukee, Wis., and crossing the North Menominee canal at an elevation of 38 ft. above water-line. In designing this structure it became necessary to provide for an opening 68 ft. in the clear at the canal, to permit the passage of large vessels to and from the coal yards and other establishments located in the neighborhood.

Dock property being very valuable on both sides of the canal, it was out of the question to use an ordinary swing bridge, even if constructed with unequal arms, since it would prevent vessels from mooring close to the bridge, and would otherwise obstruct the channel, which at this point in quite narrow. It was also thought advisable to locate the opening as near the middle of the stream as possible. For these reasons the City Engineer, Mr. Geo. H. Benzenberg, M. Am. Soc. C. E., decided to adopt some type of a lift bridge, as best suited for the locality, and accordingly prepared specifications, stating loads, working stresses, quality of material, etc., but leaving the general design to the bidders.

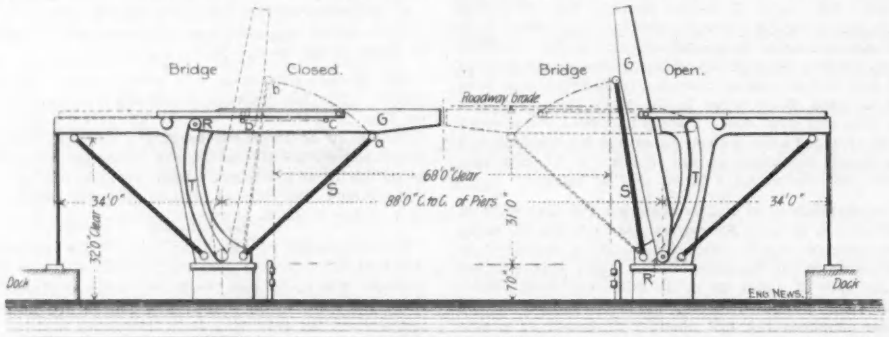


FIG. 1. DIAGRAM ILLUSTRATING OPERATION OF FOLDING DRAW SPAN, 16TH ST. VIADUCT.

In the subsequent competition the lowest bidder, the Wisconsin Bridge & Iron Co., was awarded the contract for the bridge designed by the writer and shown on the accompanying plans. It is believed that this structure, being somewhat novel in its design, and calculated for heavy loads, may be of interest to the engineering profession in general, and the writer has, therefore, prepared this description with a view of promoting discussion of its features, compared with those of similar bridges.

The essential parts of each half of the structure are shown in Fig. 1, and consist of main girders, G, carrying the floor, etc., supported by a swinging strut, S, near one end, and by rollers, R, near the other end. These rollers, which are fastened to the main girders, roll on a stationary curved track, T, of such form that when the strut, S, swings through the arc a b, the center of gravity of the swinging portion, which is at C, is moved back in a horizontal line, from C to D.

The curve of the track is so constructed that the resultant of the weight of the moving portion passing through the rollers is perpendicular to the tangent of the curve, no matter what the position of the main girders. The moving portion is, therefore, always in equilibrium; and, since no part of the dead weight has to be lifted, only the frictional resistances have to be overcome in operating the bridge.

It is also evident that any additional uniform load extending over the floor of swinging portion (such as snow or mud), while slightly increasing the friction, will not disturb the equilibrium so long as the resultant passes through the center of gravity. For a concentrated moving load, or one extending uniformly over part of the floor only, the roller end of girder has to be latched, in order to prevent upward or downward motion. The track has also to be anchored to prevent overturning, as shown in Fig. 1.

In the Sixteenth St. lift bridge each of the main girders is double, with webs 18 ins. apart, strongly connected by diaphragms built of angles and plates at each floor beam. The girders of the stationary portion are also double, having webs 42 ins. apart. The stationary girders straddle the moving girders, and permit their ends to swing freely between the stationary girders. The webs and flanges of the stationary girders are extended down to the stone piers, forming supporting columns, to which the tracks, made of planed steel plates, are fastened. These columns are slotted to permit the motion of the rollers, as shown on the detail plan, but are reinforced by heavy curved Z bars, connected by plates riveted to the webs. There is also lateral bracing between each pair of columns.

A steel shaft is firmly secured to the main girders, and around it a series of steel spring rollers have been placed, in order to reduce friction as much as possible. By this arrangement it is believed any slight irregularity of the tracks will be equalized. The swinging struts, supporting the outer end of the span, are composed of channels laced together and well braced laterally and have hinges of cast steel. Provision is made, of course, for keeping all journals well lubricated.

There is also a strong strut extending backwards from the foot of the main columns to the end of the stationary girder. At this point four steel anchor rods, 3×¾ ins., have been attached, and are connected to I-beams supporting masonry of the necessary weight in the usual manner.

The operating machinery, which is very simple, is shown in detail on the plans, and consists of two horizontal operating struts attached to the main girders at the center of gravity of the swinging portion. Each is composed of three channel bars, to which a cast steel rack is bolted. These racks are moved by pinions keyed onto the main shaft, which also carries a wormwheel, turned by a worm of the Albro-Clem pattern, fastened on a driving shaft coupled to the electric motor.

There is also a hand gear to be worked by a turning key in the usual manner.

In order to prevent shocks in closing the bridge, a strong spiral spring and a lever have been attached to the operating strut in such a manner that when the bridge is closed this spring is compressed, and, therefore, absorbs the surplus power in case the motor is not stopped at the proper moment.

The bridge has a 40-ft. roadway and two 6½-ft. walks, or a total width of 53 ft. between handrails, except on the stationary portion, where the walks are 3 ft. wider. The roadway has a crown of 2 ins. The roadway floor is composed of a lower layer of 3-in. and an upper layer of 2-in. white oak, spiked to nailing strips bolted to the longitudinal stringers, which are spaced 30 ins. c. to c. The stationary portion is paved with 7-in. cedar blocks.

In proportioning the bridge, a uniform live load of 100 lbs. per sq. ft. of roadway and 80 lbs. per sq. ft. of sidewalk was used; but the roadway stringers and beams were calculated for 10-ton electric cars, on tracks 10 ft. c. to c. A very strong lateral bracing was introduced, not so much from fear of high wind pressure as with a view of connecting all parts thoroughly, and experience has proved the structure to be exceedingly stiff laterally in all positions. The metal used throughout, except for minor details, was steel of 56,000 to 63,000 lbs. tensile strength. It was tested by the Pittsburg Testing Laboratory. When the bridge is fully opened the floor of the swinging portion forms a most efficient gate for both roadway and walks, and thus prevents accidents. There is a slot in the floor of the sidewalks to permit the motion of the operating strut. This slot is covered with a ¾-in. thick checkered plate, made in sections hinged together and resting on shelf angles fastened to the inside of the webs of the main girders. The section nearest the center of the bridge is fastened to the sidewalk floor of the swinging portion. When the operating strut pulls the bridge open, it pushes this covering under the sidewalk floor of the stationary portion, and draws it back again into position when the bridge is closed. This arrangement, while very simple, has been found to work very well in practice, and to look well also. The length of the floor of each moving portion is about 42 ft., of which only 20 ft. appears above the floor line when the bridge is open. The weight of each moving portion is 65 tons.—The bridge operates very successfully. In ordinary weather it has been fully opened by the electric motors in 15 secs. and closed in 20 secs., without any perceptible vibration. On this occasion a voltmeter and an ammeter in the circuit indicated 414 volts, and 20 amperes, or about 11 HP. Ordinarily, the bridge is opened in 30 secs. by electricity. It can also be operated by hand power by two men. The total cost of the bridge complete was about $42,000.

The advantages of this type of bridge may be summed up as follows:

1. It permits a floor of the heaviest kind, with paving, or of asphalt and concrete on buckle plates, without making the bridge too dangerous to operate, since there is perfect balance of moving portion at all times and seasons.

2. On account of the peculiar motion of the swinging portion, the effects of wind forces are much reduced, and can easily be controlled.

3. The central deflection is small, due to the supporting swinging struts.

4. Both ends of streets or approaches are closed by the bridge floor when the bridge is opened.

5. It requires no center pier, and permits a single wide channel for vessels.

6. This construction requires no towers projecting above the roadway, and obstructing the view of the river.

This type of bridge has recently been patented by Mr. Max G. Schinke, Assistant City Engineer, of Milwaukee, from whom the Bridge Co. secured the state right. The following gentlemen on the staff of the Wisconsin Bridge & Iron Co., have cooperated with the writer in making this structure a success: Mr. Beverly Worden, Chief Draftsman; Mr. S. B. Harding, Superintendent of Shops, and Mr. J. F. Jackson, Superintendent of Erection.

TEST OF A NEW DESIGN OF ELECTRIC RAILWAY POWER STATION.*

By Geo. W. Colles, Jr., Hoboken, N. J., and Edward B. Gallaher, New York city, Graduates of the Class of 1894, Stevens Institute of Technology.

The design of the power station, the test of which forms the subject of this report, is called new, because, although the Westinghouse "Kodak" arrangement has for some time been on the market and become more or less common in electrical plants, yet the general arrangement of the station, the Manning vertical boilers, the mechanical draft, economizer, and feed-water heater, combined with the "Kodak," all in a station of very moderate size, form a departure from the usual practice in these lines, which, in the writers' opinion, entitle it to this designation.

The station mentioned is, in fact, one of the most recent designs of Westinghouse, Church, Kerr & Co., having been erected by them about two years previous to the test, for the Winchester Avenue R. R. Co., at West Haven, Conn. The road operated by it is of the ordinary city and suburban character, running between New Haven and the place just mentioned, with various branches. The station itself and its apparatus were well and fully described in the "Electrical Engineer" of Feb. 1, 1893, to which the reader is referred for a more complete idea of the same than is here given.

The object of the present test was principally to bring to light the actual value of this type of

*Awarded first prize in Engineering News Thesis Competition of 1894.

power plant as a factor in economical street railway operation. It is, perhaps, not surprising that so little is really known in this direction, and so few reliable tests have been made, considering the so recent establishment of the electric railway as a commercial enterprise and the rapid progress and changes it has experienced and is even now experiencing. But it must be admitted that comparatively little is known as to the relative value of different power stations in and of themselves. Even the "Kodak" engine and dynamo unit, while common enough in practice, must be acknowledged to be a more or less unknown quantity, as regards its actual economy in existing railway stations. One of the most important of recent tests is that of Messrs. Pike and Hugo, at Minneapolis and St. Paul, reported to the American Society of Mechanical Engineers at the meeting held in August, 1893; in which, among other things, the merits of concentrated and subdivided power were compared; and many interesting data given. In the present essay, no comparison tests have been attempted, but a number of important quantities have been determined which may be compared with such previous results as we already have. The most important of these are:

1. The actual cost per horse-power and per car-mile of power furnished to the line.
2. The evaporative performance of the Manning boilers.
3. The economy of the cylinders of the Westinghouse compound engines, or steam per indicated horse-power per hour.
2. The station efficiency, or per cent. of the indicated horse-power actually delivered on the line as electrical horse-power.
5. The advantages and economy of the mechanical draft and economizer, as compared with the usual chimney and natural draft.
6. The efficiency of the line.

Description of the Plant.

Before giving any details as to the tests or their results, it may be well briefly to describe the station and road connected with it, with some data and dimensions.

Location.—Already given.

Power Station.—Interior dimensions, 72 × 31 ft. Construction, brick with wooden roofing. Generator room designed for a total of 960 HP. in six "Kodak" or direct-driven units of 160 HP. each. Boiler-room designed for 750 HP. in five units of 150 HP. each. There are also a small draft room, containing the stack and mechanical draft, a coal bunker and chute for unloading coal from barges at the adjacent wharf.

Engines.—Three 160-HP. Westinghouse compound, run with jet condenser and separators. Dimensions: Diameter of h.p. cylinder, 13 ins.; l.p. cylinder, 22 ins.; length of stroke, 13 ins.; connecting rod, 35 ins. Cylinders, single acting. Speed, about 290 revs. per minute.

Generators.—Three 120 K.-W. Westinghouse railway units, driven direct by engines through flexible coupling. Dynamo frame insulated from its bed and coupling. Floor dimensions of each engine and dynamo unit, 6 ft. × 16 ft. 4 ins.

Boilers.—Three Manning vertical tubular, of 150 HP. each and one of 250 HP. Following are the dimensions:

	Nos. 1, 2 & 3.	No. 4.
Inside diam. of shell above furnace	56 ins.	74 ins.
Diameter of furnace	66 "	84 "
Height of furnace	44 "	44 "
Number of tubes	152	244
Length of tubes	15 ft.	15 ft.
Outside diameter of tubes	2½ ins.	2½ ins.
Heating length of tubes, water	11 ft.	11 ft.
Heating length of tubes, steam	4 "	4 "
Heating surface, water	1,175 sq. ft.	2,150 sq. ft.
Heating surface, steam	410 "	738 "
Grate area	23.76 "	38.48 "
Area of horizontal water surface at height of glass gage	11.92 "	20.18 "
Volume represented by 1-in. height on glass gage	0.9935 cu. ft.	1.682 cu. ft.

Apparatus Accessory to Boiler Room.—Two feed-pumps, each of full boiler capacity; Deane jet condenser and pump, using salt water from adjacent harbor for condensing; Lowcock economizer with by-pass for chimney gases in case of repairs; National feed-water heater, using exhaust steam from pumps and auxiliary engines; Sturtevant fan at base of stack, which is 40 ft. high and 4 ft. in diameter. Two small Rice oscillating engines (one as relay) for operating fan, and one for operating flue cleaner in connection with economizer. Three Westinghouse steam loops for returning water from separators to boilers. Injector, petroleum injector, ejector, etc. All steam and hot-water piping in station, boiler shells, smoke connection to economizer, etc., heavily covered with magnesia.

Roadbed.—Length of all tracks, 14.18 miles; double track, 4.89 miles; single track, 4.40 miles; total street length, 9.13 miles.

Distances from power station: New Haven end of main line, 4.37 miles; West Haven end of main line, 2.47 miles; end of Congress Ave. branch, 3.22 miles; end of City Point branch, 1.65 miles.

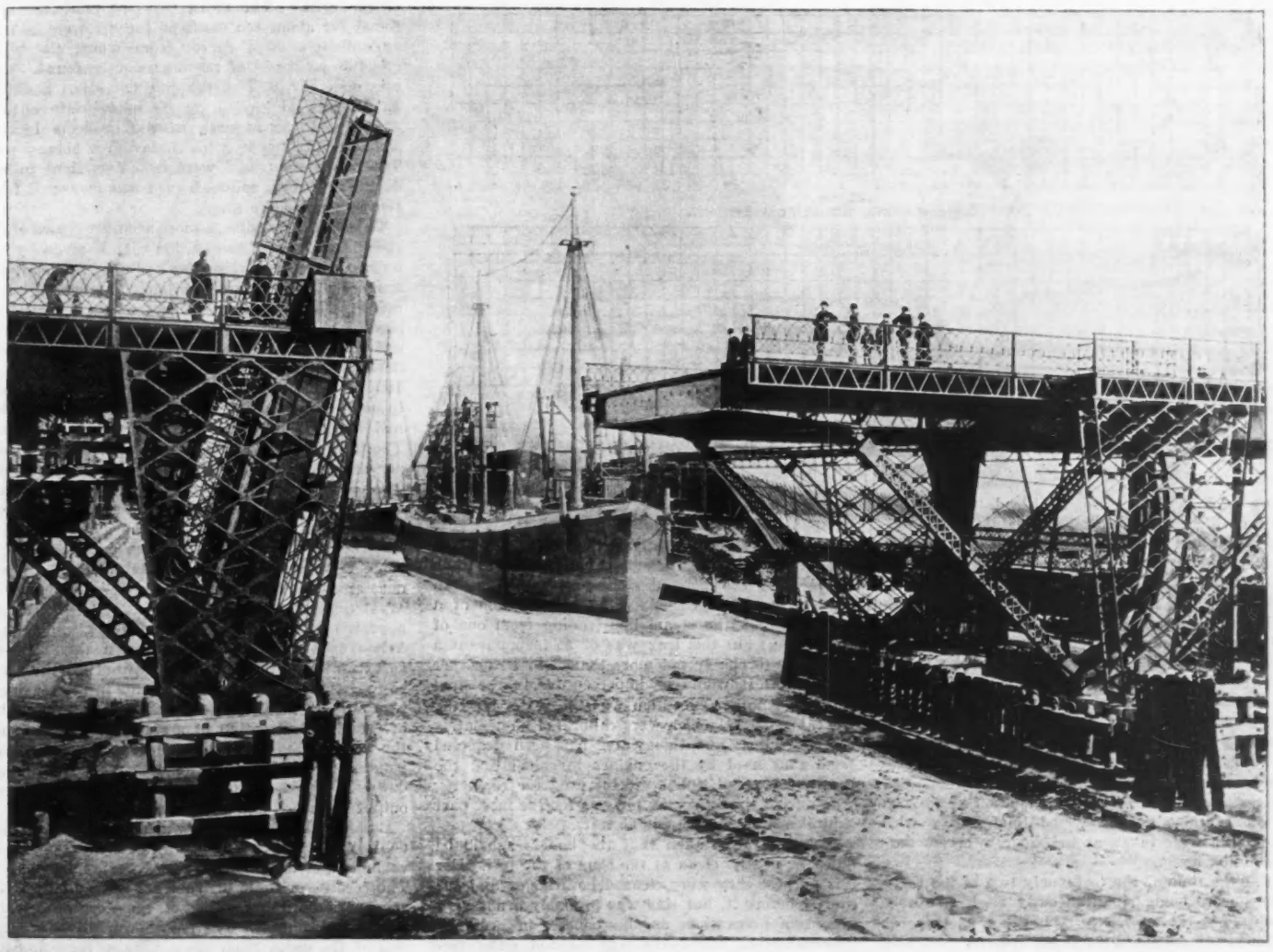


FIG. 3. PERSPECTIVE VIEW OF FOLDING DRAW SPAN OF SIXTEENTH ST. VIADUCT; MILWAUKEE, WIS

Grades (approximate values).—2%, 5,670 ft. track length; 3%, 300 ft.; 3½%, 600 ft.; 4%, 2,000 ft.; 4¼%, 700 ft.

Curves.—Radius 50 to 100 ft., 16 of 90° each, 12 of 45° (double track curves on the road estimated as two each).

Line.—Feeders, one of No. 0000 wire and two of No. 000. Trolley wire No. 0 hard drawn. Poles, iron in New Haven, wood in West Haven, spaced 125 ft. apart. Sections into which line is divided by cut-outs, 6. Ground plates, 3 or 4 water connections. Rail connections.—The rails were being connected with copper bonds at the time of the test, and the work was then partially completed.

Rolling Stock.—Total number of motor cars, 42.

Operation of the Road.—Car-miles: Average number per day for 1893, 2,040; maximum number for any one day (May 30, 1893), about 3,500. Number of cars operated simultaneously, 16 to 20, mostly (⅔ to ¾) double motor and a few trailers. Daily average miles per car 112.

Passengers.—Average number per day for 1893, 11,000. Maximum for any one day (May 30, 1893),

44,000 (about). Average passengers per car-mile, 5.39.

The road is operated for the most part between the hours of 6 a. m. and 12 midnight, the engines being started about 5:30 a. m. Fires are banked shortly after midnight and steam raised between 4:30 and 5:30 a. m.

Method of Conducting the Tests.

Two series of tests were made, the first being intended principally as preliminary, in order to discover the best method of taking observations, and what hitches and breakdowns, if any, were likely to occur. The observations in these were taken as carefully, although not quite so fully, as in the final tests, in order that they might be used as checks on the latter.

In the engine room it was deemed advisable, instead of the long tests usually made, to make shorter ones, containing, however, about the same number of observations, in order to compare the various performances of the station at light and heavy loading. Therefore, light-load tests of four hours each were made near the middle of the day, and heavy load tests of two hours each—this being about the time the heavy load continued—towards night. The observations in this part of the test, with one exception, to be mentioned, were all made at 2½-minute intervals; cards from each indicator and electrical measurements being taken simultaneously on signal. Data not immediately connected with the engines and dynamos, but mostly with the boilers, were taken continuously during the whole period of the engine tests, that is, for 48 hours. This time was divided into three periods of 9, 24 and 15 hours, respectively, during which the road was in operation for 9, 18 and 9 hours, and the power station for 9, 18½ and 9½ hours, respectively. All observations not connected immediately with the engines were taken at half-hour intervals during running hours.

As at the time of the tests only two of the three engines were being simultaneously used, two only were used in the tests, Nos. 1 and 3—i. e., those at the ends of steam line—being chosen for this purpose. Four tests in all were made on the engines and dynamos: The first beginning May 1, 1894, at 5 p. m., and ending at 7 p. m.; the second beginning May 2, at 10:15 a. m., and ending at 2:15 p. m.; the third beginning May 2, at 5 p. m., and ending at 7 p. m.; the fourth beginning May 3, at 9 a. m., and ending at 1:25 p. m. During the fourth test, at 10:45 a. m., there was an accident to one of the indicator rigs, which occasioned a delay of 25 minutes; and this was compensated by 25 minutes added to the time of testing, thus making the real length of this test four hours. The observations were so carefully taken that no sensible error, we think, was caused by this delay.

As regards the remaining data, the test began at 3:09 p. m., May 1, 1894; the first period ended at 12 midnight (coal being measured until fires were banked, shortly after midnight), May 1; the second period at 12 midnight (with the same proviso), May 2; the third period and the entire test, at 3:09 p. m., May 3. Banking coal was included in that used during the first and second periods; starting coal in that used during the second and third. The boiler test was started with the fires in as low a condition as possible, coal on the grate being then estimated; and the test was ended in the same manner.

The most important of the data taken during the test are given in tables in the appendix to this report. (Not printed.—Ed.) Besides these were taken at half-hour intervals during running hours observations of temperatures, by the two Barrus calorimeters, and simultaneous steam pressures; at half-hour intervals during the engine tests, measurements of the water used by pumps and all sources other than the engines themselves, as it flowed from the general drain-pipe; and at the beginning and end of each of the three periods above mentioned, the fuel record. Also, the leakage of the boilers at the blow-off pipe was measured at night, when the road was shut down. The record of the number of cars on the line during the test, and the number of car-miles made, were obtained from the company's regular schedule.

Care was taken throughout the engine tests that all outlets for water or steam used in the station, other than the general drain-pipe and the condenser, should be closed; with the exception of a single leak in the steam line leading from one of the boilers; but this leak was of so insignificant a character (probably not more than 5 to 10 lbs. per hour) that it would be imperceptible in the final results. Another exception was the water used by the calorimeters, which were calibrated immediately after the test; and this water has been deducted from that used by the engines in calculating the results. A small siphon ejector used for removing water from the condenser pit was for the most part kept closed during the engine tests.

Care was also taken that the boilers should be quite or nearly clean at the time of the test. For this purpose they were cleaned both inside and out shortly before it, but this was probably a not very necessary precaution, as the boilers, in ordinary circumstances, it appears, are cleaned quite frequently; and the water used contains little scale-forming material. Petroleum is used as a scale-preventive.

Precautions to Insure Accuracy.—(Pressure on our space compels the omission of the authors' account of the careful manner in which all measuring instruments used were tested and standardized. We briefly abstract it as follows: These instruments included Green thermometers, Worthington water-meter, Weston electrical instruments, weighing scales, steam gages, vacuum gages, draft gages, indicator springs, barometer and automatic recording instruments. The water-meter was tested at the various rates of flow by observing simultaneous readings of the meter and the height of the water in a tank of known diameter. It was placed between the heater and the economizer, and all water used in the station, except the condensing water, passed through it. In calibrating the various instruments, curves were made on cross-section paper, showing the relation of the true and the actual readings at the different points, by which the proper corrections were found with least liability to error. Further, all the arithmetical operations were gone over at least twice, in different ways, or by different persons, to ensure accuracy. In measuring the indicator cards, after obtaining the areas by the planimeter, the areas were corrected at once for the error of the spring and the error of the rig in the following manner: A number of the cards of each set (i. e., all those from the same spring) of different areas were chosen, and each divided by ordinates into ten spaces, not equal on the card, but representing equal distances traversed by the piston. The average pressure for each space, on forward and back pressure lines, found from the particular values of the spring at those heights, was then obtained, as in the method used at the Brooklyn Navy Yard (see also a paper by Prof. D. S. Jacobus, in "Stevens Indicator," April, 1894), and the mean effective pressure for all the spaces added together and divided by 10 for the M. E. P. of the card. The mean effective pressures thus found for about ten cards of the set were laid off as ordinates of a curve, from which the mean effective pressures of the others were found. This was done for each of the different sets. Each M. E. P. was multiplied by its appropriate engine-speed, and the average of the products by the stroke and piston area for the average horse-power. The planimeters used were tested previous to and during the work, and each card was measured from two to four or five times.

To secure, if possible, a more accurate record of the electrical output of the station than is given by the ordinary recording voltmeter and ampere meter, the authors devised, as an experiment, a recording wattmeter. They replaced the fixed coil in a Bristol recording voltmeter, by one carrying the full current delivered by the station. A similar instrument was described in the "Electrical Engineer" of June 6, 1894; but the one devised by the authors is claimed to have been the first of the kind ever constructed and the only one ever used for testing purposes. The fixed coil of fine wire was replaced by a copper casting, so shaped that the ring part was of the same size as the removed coil, and cut to contain two turns. The cross-section of copper in each coil was about 0.2 sq. in., so that the average current density was about 1,500 amperes per sq. in. The clock movement caused a revolution of the chart once an hour. The instrument was calibrated by a Weston ammeter and voltmeter, and its readings appeared to be fairly constant for a given output. When used in the test, however, a thin strip of soft iron in the movable coil appeared to take a set so that there was a gradual decline in the readings. The authors also point out that the determination of the electrical output of a station by multiplying the average amperes by the average potential will generally give a greater quantity than the actual output, as when the potential is highest the current output is lowest, and vice versa.

Besides the recording wattmeter the authors used recording gages, showing steam pressure, vacuum, potential and temperature of flue gases. The records of these instruments were used merely as checks on the reading of the accurately calibrated instruments. The cuts herewith show samples of the cards from these various recording instruments, including the wattmeter.—Ed.)

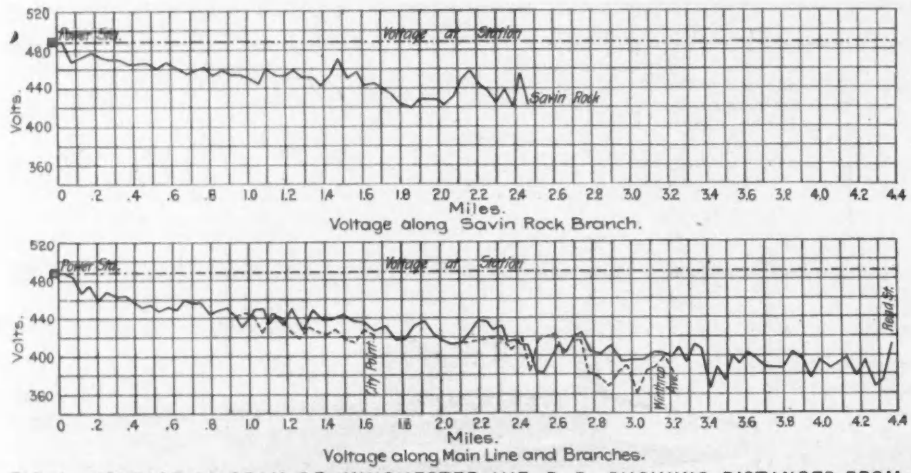


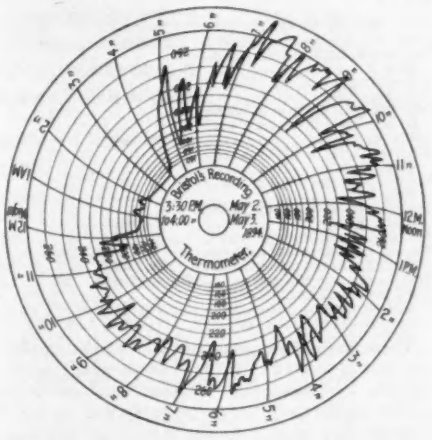
FIG 1 VOLTAGE DIAGRAM OF WINCHESTER AVE. R R, SHOWING DISTANCES FROM POWER STATION.

Summary of Results of all Tests: Performance of Evaporative System.

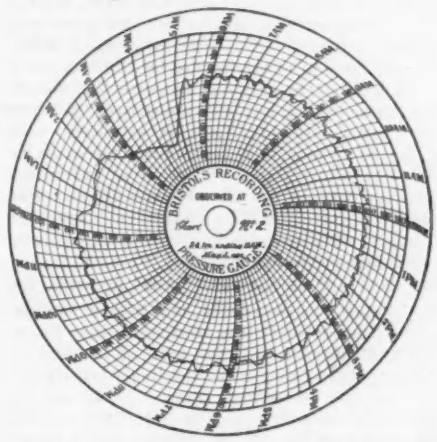
Following are the data relating to the performance of the boilers, heater, economizer, etc. (Pressure on our space compels the omission of all but the data of the final test.—Ed.)

Duration of test, ...hours.	48
No. of operating hours during test.....	36
Boilers used .....Nos.	1, 2, 3
Total water used .....lbs.	229,760
Leakage from blow-off pipe ..... "	14,400
Total water evaporated ..... "	215,360
Total coal used(a) ..... "	20,669
Total ash(b) ..... "	3,202
Per cent. of combustible (b).....	82.69
Average quantities (c).	
Steam pressure, by gage .....lbs.	130.1
Vacuum in condenser .....ins. mercury.	23.9
Height of barometer ..... " "	30.07
Temperature of atmosphere.....deg. Fahr.	74.4
Flue-gases after passing economizer " "	272.8
Feed-water, city main ..... " "	51.4
Feed-water, after passing heater... " "	200.6
Feed-water after pass'g economizer " "	235.4
Draft in flue .....ins. of water	.184
In firebox of boiler No. 1..... " " "	.146
" " " " " 2..... " " "	.148
" " " " " 3..... " " "	.150

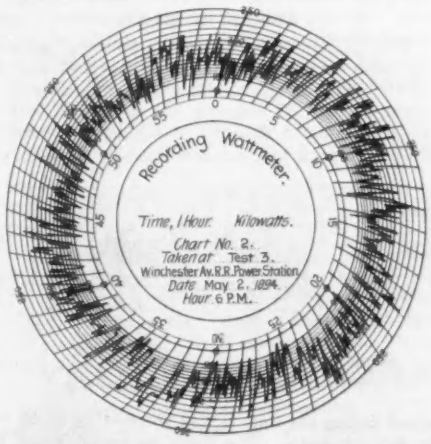
General weather conditions during test....clear and dry.	
Water evaporated:	
Per lb. coal, actual.....lbs.	10.42
" " " from and at 212°..... "	10.64
" " combustible, actual ..... "	12.33
" " " from and at 212°.... "	12.59
Equivalent evaporation per lb. combustible of economizer, from and at 212°.....lbs.	0.42
Equivalent evaporation per lb. combustible of boilers and economizer combined, from and at 212° .....lbs.	13.01
Heat units imparted to feed-water per lb. combustible by economizer (g).....	459
Heat units imparted to feed-water per lb. combustible by boilers	12,163
Heat units imparted to feed-water per lb. combustible by boilers and economizer combined, being total heat extracted from coal.....	12,622
Percentage of total heat imparted by coal, due to economizer (g).....%	3.64
Percentage of total heat imparted by coal, due to boilers .....%	96.36
Heat units imparted to feed-water per lb. combustible by heater (g)	1,968



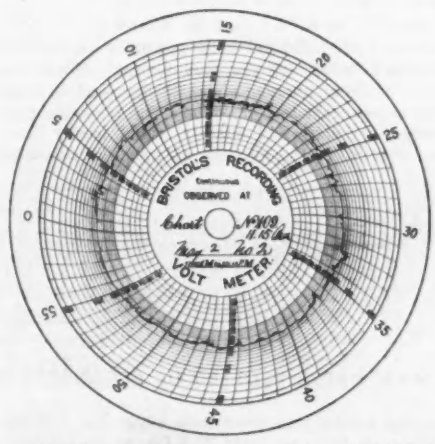
Pyrometer Record of Temperature of Flue Gases entering Stack. 3:30 P. M., May 2, to 4 P. M., May 3, 1894.



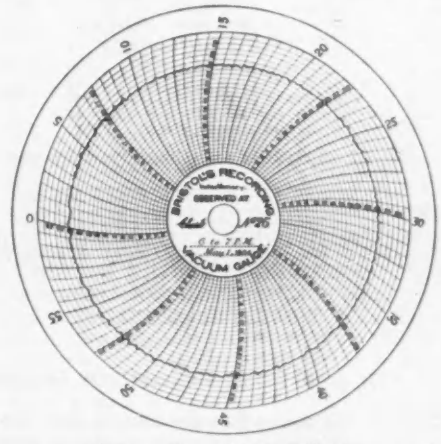
Steam Pressure Record for 24 hours, ending 11 A. M., May 3, 1894.



Record from Recording Wattmeter Constructed by the Authors; 6 P. M. to 7 P. M., May 2, 1894.



Voltmeter Record, 11:15 A. M. to 12.15 P. M., May 2, 1894.



Vacuum Record, 6 to 7 P. M., May 1. 1894.

FIG. 2. SPECIMEN CHARTS FROM AUTOMATIC RECORDING INSTRUMENTS.

Equivalent evaporation per lb. combustible of heater, from and at 212° (g) .....lbs.	2.04
Percentage of heat imparted to feed-water by heater to heat imparted by coal; being per cent. additional coal necessary to replace heater (g) .....%	15.59
Rated HP. of boilers used.....	450
Actual HP. developed by boilers used, by A. S. M. E. standard (h).....	177.1
Actual HP. developed by entire evaporative system, by A. S. M. E. standard (h).....	210.1
Per cent. of rated HP. actually developed by boilers	39.4
Water evaporated per sq.ft. of grate per hr..lbs.	83.92
Water evaporated per sq.ft., total heating surface, per hour .....lbs.	1.258
Coal burned per sq. ft. of grate per hour...lbs.	8.05

(a) Including banking and starting coal. It is estimated from 250 to 300 lbs. are used for banking.

(b) In weighing the ash for the last portion of the test there can be no doubt much of the ash was necessarily left on the grate, as the fires were too low to be overhauled; consequently the final per cent. of combustible is computed only from the two first periods of the test. Probably the true weight of ash would be about 3,000 lbs.

(c) All these averages are from data taken only during running hours.

(g) These figures include the water lost at blow-off pipe.

(h) 34½ lbs. water evaporated per hour from and at 212° = 1 boiler HP.

The figures given for the evaporation of the boilers appear indeed surprising, particularly when the low rate of combustion, and per cent. of their rated capacity actually exerted by them are taken into consideration;* and it will be remembered that these figures include banking and starting coal. Nevertheless, they confirm those given for a similar test on the Manning boilers by Prof. J. E. Denton, reported at the recent meeting of the American Society of Mechanical Engineers.**

The coal used in the final testing was obtained from the Chesapeake & Ohio R. R. Co., at $3.45 per ton, under the name of New River steam coal. A quantity of screenings (3,000 lbs.), at $1 per ton, were mixed in with it and probably added to the per cent. of ash.

The evaporative values of the respective portions of the system and the efficiency of the whole as a fuel-saver are well shown by the heat units absorbed by each and the fraction of the whole economy due to it. "Does the economizer pay?" will be the first question asked by every one on inspection of these figures. Only 3½% of the entire heat of the coal (corresponding to an evaporation of less than half a pound of water from and at 212°) is gained by the economizer, and part of this (6.3%) is lost by leakage from the boilers at the blow-off pipe. Thirty-five degrees represent the total average rise in temperature. Taking the total cost of fuel per annum as $5,800, the economizer would save about $200 per year, or probably not over $180, if we consider the steam used by the auxiliary engine for cleaning the tubes. With interest at 6%, and allowing 3% as a minimum for depreciation, it appears that in present circumstances the economizer would be just paying its way if the original cost of installation was $2,000. This would be a favorable estimate, as it does not consider extra labor. We are not in possession of the exact figures of cost of installation, but the chances in favor of and against the economizer appear to be nearly even.

It is claimed, we understand, by Messrs. Westinghouse, Church, Kerr & Co. that the total cost of their mechanical draft and economizer system does not, in general, exceed that of a good brick chimney and foundations, besides having the advantage of economy in service. That may be true; but having settled in favor of the former, the question arises whether we would not be still more the gainers by leaving out the economizer and installing only the mechanical draft. One thing that must be considered, and one of some importance, is the fact that the installation of foundations, etc., has been on the basis of about 1,000 HP., of which only about half is at present installed as engine and boiler power. So that, in the end, it is more than likely that the economizer would pay for itself, leaving besides a margin of saving. It ought also to be remembered that what applies to power stations of 1,000 HP. will not necessarily apply to those of larger capacity. What the economizer might do, also, if not forestalled by the heater, is quite another consideration. Of the value of the latter as a fuel-saver—small, inexpensive and out-of-the-way as it is—in the absence of any other means of disposing of exhaust steam, there can be no question.

The general efficiency of the evaporative system is seen to be remarkably high, about 12,600 heat units being extracted from each pound of combustible during the final tests—a figure which we doubt can be equaled, not to say exceeded, by any other railway station of similar capacity. As the flue gases leave the economizer at a temperature of about 200° above atmosphere, we may conclude that from 850 to 1,150 heat units* per pound of coal are here lost; and assuming 2,000 heat units in all for unburnt carbon, heat in ashes, etc., the efficiency of the boilers and economizer combined might be roughly estimated at 86%; so that it seems there certainly remains little more to be accomplished here.

* Some of our readers may contend that it is because of these conditions; but it appears to us that we are much below the limit of maximum efficiency.

**From 12.00 to 13.41 lbs. water per lb. combustible from and at 212°, averaging 12.77, with soft coal.

Performance of Engines and Dynamos.

The following are the principal results obtained from observations taken in the engine room: (Only the averages of all tests are here given.—Ed.)

Duration of test .....hours.	12
Engine and dynamo units used.....Nos.	1 and 3
Steam pressures by gage:	
Average .....lbs. per sq. in.	132.1
Maximum ..... " " " "	140.0
Minimum ..... " " " "	117.5
Average vacuum in condenser ....ins. mercury	23.9
Variation of total pressure .....%	15.6
Engines.	
Engine No. 1:	
Average I. HP.	126.8
Maximum I. HP.....	212.4
Minimum I. HP.....	25.8
Factor of loading (ratio of average to maximum HP.)	.597

* Assuming a factor 4.24 to 5.77 per degree per lb. coal (Wilson "Steam Boilers," 5th ed., p. 258).

Ratio of minimum to average I. HP.	.203
Average HP. of high-pressure cylinder	65.9
Average HP. of low-pressure cylinder	60.9
Per cent. of work done by h.-p. cylinder	52.0
Per cent. of work done by l.-p. cylinder	48.0
Average revolutions per minute	275.
Maximum " "	300
Minimum " "	254
Variation of speed ....%	24
Engine No. 3:	
Average I. HP.	157.3
Maximum I. HP.	262.2
Minimum I. HP.	76.6
Factor of loading	.604
Ratio of minimum to average I. HP.	.487
Average HP. of high-pressure cylinder	60.5
Average HP. of low-pressure cylinder	96.8
Per cent. of work done by h.-p. cylinder	38.5
" " " " " l.-p. "	61.5
Average revolutions per minute	2.8
Maximum " "	322
Minimum " "	270
Variation of speed ....%	17.6
Both engines:	
Average I. HP.	284.0
Maximum I. HP.	464.2
Minimum I. HP.	119.0
Factor of loading	.611
Ratio of minimum to average I. HP.	.419
Per cent. of total work done by engine No. 1.	44.6
" " " " " " " 3.	55.4
Electrical data (from tests at power station).	
By voltmeter and ammeter:	
Average amperes	300.2
Maximum amperes	500
Average volts	479.4
Maximum volts	518
Minimum volts	438
Variation of voltage ....%	16.7
Average electrical HP.	190.6
Maximum electrical HP.	303
By recording wattmeter:	
Average output ....E. HP.	184.0
Maximum average continuous output:	
For 5 minutes.... E. HP.	269
For 1 minute .... " "	320
For ½ minute .... " "	326
Maximum recorded output .... " "	346
Factor of loading (ratio of average to maximum load)	.532
Economy of engines and dynamos.	
Total water used during test, including pumps, auxiliary engines and boiler leakage....lbs.	73,141
Total water used by engines during test.. "	57,480
Total water used by pumps, auxiliary engines, and boiler leakage ....lbs.	15,652
Total water used by pumps and auxiliary engines only ....lbs.	12,052
Per cent. of total water used for pumps, etc..	21.40
Total water used per I. HP. per hour....lbs.	21.37
Water used by engines per I.HP.per hour. "	16.87
Total water used per E. HP. per hour*.... "	31.98
Water used by engines per E.HP.per hour* "	23.13
Station efficiency* (ratio of E.HP. to I. HP.)%	67.11
Coal used per I. HP. per hour, at rates of evaporation already given ....lbs.	1.995
Combustible used per I. HP. per hour, at rates of evaporation already given....lbs.	1.734
Coal used per E. HP. per hour, at rates of evaporation already given ....lbs.	3.068
Combustible used per E. HP. per hour, at rates of evaporation already given....lbs.	2.611

* Computed from ammeter and voltmeter measurements.

with the high, are reduced to the same scale as the latter for comparison.

During the preliminary tests, some evidence of hunting was noticed on Engine No. 3, although not nearly so distinctly as later, and was not thought to be of sufficient importance to call for any action. But it may be worth while to mention, that just previous to the regular tests the governor of this engine was overhauled (we believe on account of a nut which had been displaced); and immediately after them, on account of the pounding, the connecting rod was fitted with a new wrist-pin. Cards taken several weeks subsequent to the test showed no signs of the "hunting."

That this event affected the area of the indicator cards is practically certain; for some of them show a lapping over, in high and low cylinders; but it is not likely that it affected them very much, for the indicators used (which had, in fact, not given any trouble in previous tests) were immediately afterward subjected to a careful test at Stevens Institute, by Prof. D. S. Jacobus, under various normal and extreme conditions, and pronounced to be in perfect order. Moreover, several indicators were tried on the two cylinders, with about the same result as to the appearance of the cards; and in the fourth test that on the low-pressure cylinder was replaced by another, which, while it gave smoother and more regular cards, differed comparatively little in their proportionate area.

One cause of the hunting (and perhaps the prime cause) was no doubt the higher average speed of Engine No. 3 than that of Engine No. 1; which was sufficient to throw most of the load on the former engine, thus rendering its governor peculiarly sensitive to sudden changes. Among its effects were probably the large proportion of the whole work done by the low cylinder, and a lowering of efficiency between cylinders and bus-bars. The variation of speed, although not much greater than that of the steam pressure, may also, we think, be partly traced to this source.

Granting, as we do, that the figures given above for water per indicated horse-power are somewhat too small, what are the true figures? Those for power per hour average about 25 lbs.; and of these there is not a shadow of doubt. The true efficiency between cylinders and bus-bars could hardly have been over 80%; the average of rough calculations

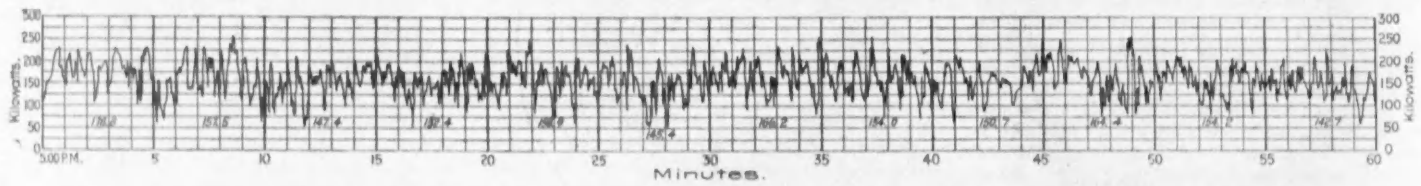


FIG. 3. SPECIMEN RECORD OF RECORDING WATTMETER PLOTTED ON CROSS-SECTION PAPER, FOR HOUR 5 P. M. TO 6 P. M.

Many of the figures just given—more especially the water per indicated horse-power—appear even more remarkable than the previous ones for the evaporation of the boilers; but this time we must allow an error, causing the indicated horse-power to appear greater than it really was. This error, together with some other features, in particular the poor regulation, is accounted for by an unforeseen contingency, namely, the hunting of the governor on Engine No. 3.

Hunting of the Governor.—This incident, which we understand is not a new one in this type of engine, occurred in the engine mentioned, during the whole of the final testing, and that in a marked degree, as evidenced, not only by the character of the cards taken from it, but also by the rapidly intermittent pounding and flashing at the commutator. Samples of cards showing this peculiar feature are given, of which the maximum card taken, No. 60 of Test II., is perhaps the best example. The late, hesitating admission in the high cylinder and corresponding release in the low, with similar characteristics at the other end of the stroke, show the feature under consideration very plainly. Several other cards from this engine, given herewith, also show it more or less perfectly, and in fact nearly all were of this type. All cards from Engine No. 1 were, as far as could be noticed, perfectly normal. The low-pressure cards given, taken simultaneously from the preliminary tests gave about 75. Calling it, however, 82%, we have 20.6 lbs. as an average of the water used by the engines per horse-power per hour, and 26.2 lbs. for the total water used, which we think it will be agreed are surprisingly low. Few electric power stations, of any size or type, could make as good a showing. The Westinghouse Company claim, we believe, as low as 18 lbs. for their compound condensing engine, but this would hardly be realized except under favorable conditions, not found in an electric railway station.

Passing to the fuel data, the high rate of evaporation and low consumption give us the figure 3.08 lbs. for the total weight consumed in the station per hour, for one electrical horse-power delivered on the line. But as this is reckoned from the output during well-loaded hours, a fairer figure for comparison would be obtained by dividing the total coal used per car-mile in one or more entire days by the station output per car-mile. This will give about 3.6 lbs. per electrical horse-power hour at the station.

In passing, we may mention that the apparent reason for so low an average voltage, as appears in the table, was that the engineer kept the voltage at 500 by the station voltmeter according to orders; and it was found that this instrument was 15 to 20 volts too high, as measured by the Weston instruments.

Quality of the Steam.

Some interest attached itself to this element, beyond that relating to the engine economy, inasmuch as the makers of the Manning boilers claim for them considerable advantage in the superheating surface. A Barrus calorimeter was attached to the steam-pipe leading to each of the two engines used during the test, just behind the separators; and as the steam-pipes were well covered with "Magnesia Sectional" covering, it may be assumed that the quality of the steam was nearly the same as on entering the pipe from the boiler. Owing, however, to faulty observations, the measurements showing priming are not considered sufficiently trustworthy to be of service. Those showing superheating, which show the general character of the steam, are given below:

Period of test.	Average quality in Steam pipe No. 1.	Average quality in Steam pipe No. 3.
2½ hours, 9:15—11:45 a. m., May 2	Less than unity.	1.0010
2 hrs., 5 to 7 p. m., May 2 (engine test No. 3)	Unity or less.	1.0032
4½ hrs., 9 a. m., to 1:30 p. m., May 3 (engine test No. 4)	About unity.	1.0058
6½ hrs., 5:15 to 11:45 p. m., May 2	.....	1.0032
6 hrs., 9 a. m. to 3 p. m., May 3	.....	1.0054
3½ hrs., 6:50 a. m. to 10:20 a. m., May 3	1.0084	
No. of measurements taken.	65	57
No. of measurements showing superheating	20	33
Maximum superheating	25° (= 1.4%)	18° (= 1.0%)
Per cent. of superheating measurements to total measurements	31%	58%

These data show, apparently, that the quality of the steam averaged very close to unity, probably slightly less; also that Engine No. 3 got slightly better steam than No. 1, probably due to the fact that it was nearer to the center of the line of boilers. The measurements were taken at half-hour intervals during running hours, and for the periods whose average is given above showed, with one exception, continuous superheating.

Leakage on the Line.

The leakage of power on the line was measured on three occasions shortly after the road had shut down, that is, after midnight. The first measurement gave 50 amperes, the second 12, and the third 0.8 ampere only, all at slightly less than 500 volts. In each case the reading was perfectly constant during the time it was noted—that is, for two or three minutes. The three nights on which the measurements were taken were as nearly as possible alike, as far as weather was concerned, that is, dry and clear, and the roadbed dry. But on the first two occasions the cars were left standing as usual, with the trolleys on the wire and the lamps turned on, whereas on the third occasion the trolleys had all been ordered off previously. It is to be noted that, there being not more than 16 or 18 cars used on the road, the normal consumption of the lights would be not more than 9 amperes, and hence the first and second readings appear somewhat startling. They were due probably to the imperfect turn of some contact switch, helped out by insulation leakage on the cars. There were at the time a number of insulation leaks in the overhead wiring, but these certainly did not seriously affect the readings, if we are to judge by the last one.

Electrical Data from Tests on Car.

Besides the tests at the power station, tests on the line were made, primarily to determine the E. HP. necessary per car, which might be used as a check on values obtained at the power station and the railroad company's record of coal per car-mile. Beside this, it was attempted to determine whether the connection of the rails by copper bonds made any perceptible difference in the line effi-

ciency. At the time of the tests, the company had commenced bonding the rails and the work was about half completed.

For this purpose a single motor car was selected and a Weston ammeter and voltmeter attached. The latter was grounded on the motor frame, the other terminal being attached to the trolley base. The road and its branches were then travelled over three times in each direction, the voltage and current being observed at intervals of 12.5 ft., as represented by the poles; the dates being May 7 and 8. The weather during this time was clear and dry, as during the tests at the station, and the condition of the road as to bonding practically the same. The results of the voltage observations are shown at length in Fig. 1. Each point on the curve represents an average of from ten to twelve observations.

The accompanying table shows the results of the test in mean values for different sections of the line:

Results of Tests of Current Consumption on a Motor Car.

	Mean distance from station, miles.	Length of track, miles.	Rail connections.	Mean voltage.	Per cent. fall in voltage.	Efficiency of line, per cent.	Fall in volts, per mile.	Average amperes to run car.	Average E. HP. to run car.
Power station	0	....	.....	487.0	0	..	..	..	....
1. Main line, Kimberly Ave.	0.48	1.78	Bonded.	456.7	6.2	93.8	63.1	17.5	10.71
2. " " power station to R. R. office	0.64	2.44	Unbonded.	460.2	5.5	94.5	41.9	17.7	10.92
3. City Point branch	1.29	0.73	Unbonded.	429.8	11.7	88.3	33.2	19.3	11.41
4. Main Line, Kimberly Ave. to Union Depot	1.29	1.48	Bonded.	438.2	10.0	90.0	22.8	20.7	12.16
5. Main line, R. R. office to Savin Rock	1.86	2.08	Unbonded.	441.8	9.3	90.7	15.1	17.0	10.07
6. Main line, Union Depot to City Green	1.95	1.18	½ bonded.	423.8	13.0	87.0	21.8	20.2	11.50
7. Congress Ave. branch	2.64	1.30	½ bonded.	401.5	17.6	82.8	32.3	19.6	10.55
8. Main line, City Green to Winchester Ave.	2.72	0.93	Bonded.	405.9	16.7	83.3	23.2	23.8	12.95
9. Main line, Winchester Ave.	3.78	1.17	Bonded.	391.2	19.7	80.3	13.9	18.8	9.81
Average for entire road.	1.67	13.11	.....	433.5	11.0	89.0	31.7	18.9	10.98
" " bonded portion	..	6.40	.....	...	..	..	33.0	..	....
" " unbonded portion	..	6.71	.....	...	..	..	29.6	..	....

The average E. HP. given being obtained from the product of the average volts and average amperes, it should be remembered that the true average will be slightly less than this, as the maximum of one of these will, in general, correspond to the minimum of the other. The following are remarkable observations:

Minimum average voltage at any one point (Sylvan Ave.)	350.
Maximum fall of voltage, per cent.	26.3
" recorded voltage,	522.
Minimum " " (Sylvan Ave.)	250.
Greatest variation of recorded voltage observations, per cent.	55.9
Maximum recorded amperes (Church and George Sts.)	85.
Maximum electrical HP.	47.3

From the former table it appears that on the whole the bonding of the rails is followed by a loss; but this, of course, merely shows that the figures are misleading. Two reasons may be given why the average fall of voltage per mile is less on the unbonded than on the bonded parts of the road. In the first place, the parts most needing it (i. e., those showing the greatest fall of voltage) were bonded first; and thus the West Haven portion, which shows the highest voltage on the line, perhaps because it lies near to the sea, at a low level and in ground well filled with moisture, is unbonded. Secondly, the parts already bonded at the time of the test were largely in isolated, disconnected sections, which would decrease the value of the bonding. However this may be, the bonding certainly did make a difference; for, while all three engines had been in regular use until about the third week in April, after that time only two were required, and not more than this were used afterwards, even at the periods of heaviest traffic, so long as the tests continued.

The most striking evidence, however, of the difference made by the copper bonding is shown in the figures given below for the cost of power per car-mile during a week in August, 1894 (since the bonding has been completed), as compared with the same item for a similar period during May of the same year.

It should be observed that previous to the new copper bonds there existed iron-wire bonds connecting the rails; but, as these were for the most part rusted away at the joints, they were practically worthless.

General Economy of the Road and Station.

(Average of Station Tests.)

Average No. of cars running during test*	16.5
No. of car-miles during test*	1,474
Average E. HP. per car	11.6
" amperes per car	18.2
" E. HP.-hrs. per car-mile	1.55
Coal used per car-mile ..... lbs.	4.76
Cost of coal per E. HP. hour ..... cts.	.473
Cost of coal per E. HP.-hour ..... cts.	.473
Cost of coal per car-mile ..... cts.	.733

* Motor and trailer reckoned separately.

The following are calculated from data furnished by the company:

	Amount used, lbs.	Total cost.	Cost per car-mile, cts.	Cost per E. HP. per hr., cts.*
Coal at $3.45 ton, incl'dg. 3,080 lbs. screenings	72,770	$109.03	.8201	.529
Oils	....	3.18	.0239	.015
Water	983,000	9.83	.0739	.048
Pay-roll	....	81.62	.6139	.396
Tot'l operating exp.	....	203.64	1.5318	.988

Total car-miles, 13,295. Coal, per car-mile, 5.473 lbs.
Total operating hours, 125.5.

* At 1.55 E. HP. to the car-mile, as previously found.

No further argument is needed for a distinction between station and line efficiency, nor any stronger proof of the value of good rail connections, than the comparison of these figures with the following, handed to us by the management, for the week ending Aug. 2, 1894, previous to which time the work of bonding was completed:

	Amount used, lbs.	Total cost.	Cost per car-mile, cts.
Coal, at $3.25 ton	88,510	$128.43	.6711
Oils	.....	3.50	.0183
Water	1,002,000	10.02	.0523
Pay-roll	.....	82.58	.4315
Tot'l operat'g expenses	.....	224.53	1.1732

Total car-miles, 19,138. Coal per car-mile, 4.625 lbs.
Total operating hours, 125.25.

	Apr. 17.	Apr. 18.	May 1.	May 2.	May 3.	Average for the 5 days.
Coal used, ... lbs.	11,122	12,583	10,412	9,915	10,013	10,989.
Passengers carried	8,942	9,229	9,933	10,059	10,070	9,678.6
Car-miles	2,006	2,006	1,992	1,982	1,992	1,995.6
Passengers per car-mile	4.457	4.601	4.987	5.075	5.055	4.835
Coal used per car-mile ..... lbs.	5.544	6.273	5.227	5.003	5.478	5.505.6
Coal used per passenger ..... "	1.244	1.363	1.042	0.930	1.084	1.133
Cost of coal per car-mile ..... cts.	.854	.996	.805	.771	.844	.848
Cost of coal per passenger ..... "	.192	.210	.160	.143	.167	.174

The station efficiency, as obtained from the tests, has been found to average 67.1%; but, for reasons previously given, the true value is probably between 75 and 80. That of the line being 89%, we have for the probable joint efficiency 67 to 71%.

It will be noticed that the amperage per car, as found from tests at the station, agrees approximately with that found by actual tests on the car. If an average of 89% of the electrical horse-power reached the car, the average from the station tests would be 10.32, which is approximately the same as actually found by the line test.

The reason for the difference between the coal per car-mile as found from station-tests and that found from the company's record has been already stated to be that the former average is for hours of greatest traffic, while the latter is an all-day average. Consequently, an all-day average for the coal per electrical horse-power-hour would be obtained by dividing that per car-mile by 1.55, which gives us 3.55 lbs.

From Mr. J. S. Badger's paper on electric railways ("Electrical World," Oct. 30, 1891), 11.6 HP. per car would seem to be a high figure. He gives the average for the electric railways as from 3.7 to 8.4 E. HP. per car, the very highest being 10.7 E. HP., this for 30-ft. double-truck cars. Nevertheless, we see that most of this is actually delivered to the car, forestalling any suspicions as to large leaks on the line. The ratio of horse-power-hours to car-miles is also about the same as the average given by Hering ("Recent Progress in Electric Railways," p. 135), namely 8 to 5, or 1.6 to 1.

There is to be noticed in the coal per car-mile a decrease of about 9%, between the middle of April and the first of May, due, it may be assumed, to the progress in connecting the rails.

Further data as to cost of operation of the station, obtained from the company's records, for the week ending May 3, 1894, are the following:

The saving of this week, over that just given in May, in coal and water alone amounts to .1706 cts. per car-mile, which, at 745,000 car-miles per annum, would amount to a yearly saving of $1,271, or with interest at 6% and depreciation at 3% would make it pay to bond the rails if the work cost anything less than $14,100. Probably not all weeks are as economical as that just given, but then the week during May would be considerably more so than one taken before the beginning of the rail connection.

To sum up, then, we have for general results of the station high evaporative efficiency joined with high economy of the engines; the two together giving an excellent fuel record; these advantages being offset by the poor regulation of the engines and consequent varying voltage. A low line efficiency at the time of the test discounts to a great extent the showing of the station, and shows the fallacy of reckoning that element by car-miles instead of electrical horse-power-hours.

Of course, in reckoning the value of any power station design by a test, many things are to be considered besides the mere actual dollars and cents necessary for maintenance. First of all is to be considered the amount of intelligent care and energetic attention which the station receives; and the difference between an active engineer and a lazy one is, it will be admitted, usually of more significance than the difference between an economical and an uneconomical design of station. In the present case, we have no hesitation in saying this must have had a good deal to do with the result.

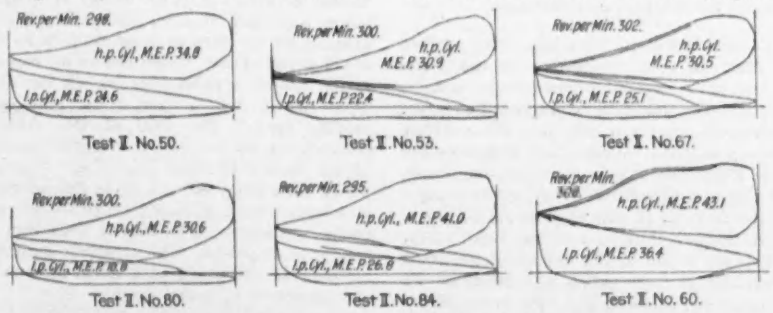

Rev. per Min. 298.
h.p. Cyl., M.E.P. 34.8
l.p. Cyl., M.E.P. 24.6
Test I. No. 50.
Rev. per Min. 300.
h.p. Cyl. M.E.P. 30.9
l.p. Cyl., M.E.P. 22.4
Test I. No. 53.
Rev. per Min. 302.
h.p. Cyl. M.E.P. 30.5
l.p. Cyl., M.E.P. 25.1
Test I. No. 67.
Rev. per Min. 300.
h.p. Cyl., M.E.P. 30.6
l.p. Cyl., M.E.P. 19.8
Test I. No. 80.
Rev. per Min. 295.
h.p. Cyl., M.E.P. 41.0
l.p. Cyl., M.E.P. 26.8
Test I. No. 84.
Rev. per Min. 308.
h.p. Cyl., M.E.P. 43.1
l.p. Cyl., M.E.P. 36.4
Test I. No. 60.

FIG. 4. SAMPLES OF INDICATOR CARDS FROM ENGINE NO. 3, SHOWING THE HUNTING OF THE GOVERNOR AND EFFECT ON FORM AND AREA OF CARDS.

(Continued on page 154.)

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The saving which may be made by treating railway ties by preservative processes is indicated by the figures for prices of ties given in the report of the Railroad Commission of Texas, just issued. Pine ties ranged from 25 to 42 cts. (yellow pine, 48 and 50 cts.), giving an average of 33½ cts., while burnetized pine ties ranged from 31 to 40 cts., or an average of 35½ cts. per tie. The range is due, of course, to the variation in the quality of the ties and the length of haul; but, as the burnetizing process can be successfully applied to the cheaper and poorer grades of wood, the cost of the treated and untreated ties is practically the same, while the former should give decidedly better service. The following is an abstract of the prices quoted:

			Average.
Pine	25	to 42	33½
" burnetized	31	" 40	35½
" yellow	43	" 50	46½
" sawed	33	" 42	37½
Cypress	31½	" 45½	38½
Oak	20	" 50	35
" second-class	.....	.....	15
Cedar	.....	.....	35
Mesquite	.....	.....	30
Switch ties, pine and cypress	.....	.....	80
Bridge ties, creosoted	.....	.....	$1

Snow removal from city streets and its cost are just now very interesting topics to the authorities New York city. Colonel Waring, the Street Cleaning Commissioner, has at last succeeded in making plain to the public that the solution of the problem is more a question of dollars than one of special organization and methods of work; though, of course, this latter element is also an important one. Reduced to its working factors, snow removal means the transfer of so many cubic yards of snow to carts and the hauling and dumping of these carts. Coupled with efficient supervision and organization, this is all there is to it as a labor problem; but when considered as a financial problem, it assumes very uncomfortable dimensions for the taxpayers. According to Colonel Waring's latest estimates submitted to the Mayor, the total street and sidewalk area of the city of New York is about 25,000,000 sq. yds., with about 34 per cent. of this area lying south of 40th St. Assuming 40 ins. of snow annually, the Street Cleaning Bureau estimates 7,329,000 cu. yds. of fresh snow as falling in one season upon the streets below 42d St.; or, at 1½ cu. yds. per cart-load, nearly 5,000,000 cart-loads. During the late storms, between Feb. 7 and Feb. 19, inclusive, 102,590 cart-loads of snow were removed, at the average cost of 57 cts. per load, each cart averaging ten loads in 8 hours, from Broadway. Upon the further assumption that only about two-thirds of the actual snowfall must be carted away, the cost of removing the winter's snow from the section of the city below 42d St. alone would amount to nearly $2,000,000. As the average annual appropriation for snow removal in years past has been about $40,000, the reasons why there should have been grounds for complaint against former Commissioners are evident. So far, Colonel Waring has had $238,000 put at his disposal for this purpose, and of this amount less than $50,000 remains unexpended.

As snow removal is but a single item in the annual expense account of the New York Street Cleaning Department, the public will await with some anxiety the demands to be yet made upon it for the other items in the account. If cold figures and a clear engineering exhibit of prevailing conditions are again resorted to as a means of educating the people of New York, some interesting facts may be brought out bearing upon this question. The first of these will be the almost self-evident fact that economic and satisfactory street cleaning is practically impossible, except with a much better maintained street surface than is now the rule in New York. The statement is made that the total cost of keeping the streets of Paris in the absolutely clean condition so often noted by tourists and writers upon this subject, is just about equal to the sum annually expended in the unsatisfactory attempt to remove the dirt and refuse from the streets of New York. But the contrast between the street surface in Paris and in New York is a very marked one, and explains the difference in general condition. In the former city, the first paving is as nearly perfect as money and close and intelligent supervision can make it, and it is constantly and jealously maintained in perfect condition. The most stringently enforced regulations prevent the disturbance of this surface on every pretence, as is the common practice here, and every measure is taken to keep the streets in a perfect condition for traffic, regardless of the wishes or aims of individuals and corporations proposing to disturb these conditions. The costly, but roomy, and efficient sewerage system of Paris also plays an active part in cleaning its streets of snow and fine dirt, and the street cleaning and scavenger service, organized and operated on an almost military basis, does the rest. In Paris every street is well swept once each day and every gutter is washed out twice per day; and all material permitting such disposal is flushed into the sewers. The more bulky offal is swept up and stowed in bags suspended from a hand-barrow, as soon as it makes its appearance upon the streets. The total force employed, including men, women and children, is about 3,200, not including the 40,000 chiffonniers, or rag-pickers of the city, who gather up every thing that has the smallest market value.

As we cannot expect to have the street surface of New York at once remodelled to the Paris standard, nor our sewerage system rebuilt so as to be of any particular use in the conveyance of street refuse other than what now gets into these sewers in every heavy rainfall, we must look in some other direction for immediate relief. Organization, discipline and a strict enforcement of old street regulations, and the framing of new ones would do much, and therein Colonel Waring has his opportunity. Garbage disposal is one of the important problems to be solved; and as every parish in London has its separate crematory, and as Paris now burns all its household waste, similar methods of disposal should be available in New York. The extension of the street-orderly system of London would seem possible and profitable; and the arrest and prosecution, Vienna fashion, of any one throwing paper or other refuse upon the streets would certainly do much to keep the streets in better condition. We have law enough and a Street Cleaning Bureau that is now organized outside of political lines. The opportunity is, therefore, presented of actually seeing what can be done in the direction of cleaning New York streets under prevailing structural conditions; and we trust that Colonel Waring will endeavor to, at least, show how it can be done and at what reasonable cost. He is an engineer, conversant with what has been accomplished in this direction here and abroad; he has executive ability and is a sharp disciplinarian; and finally, under Mayor Strong, he has the power to reorganize his force and to try any new departure which promises improvement upon past methods. He is inclined to spend money; but if he can show by results that the public obtains the full value of the money expended, all reasonable demands in that direction will probably be satisfied. Good government costs money, but it is worth it; for, as a rule, the whole public, and not favored individuals, reap the benefit.

The problem of carrying a much-used city street across a narrow river channel which is crowded with moving shipping is one which has been long presented in Chicago. The defects of the ordinary swing bridge as a solution of the problem are so familiar that they need not be enumerated here. It is sufficient to say that, although most such crossings of the Chicago River are still made by swing bridges, the demand is urgent for some better means of effecting the crossing. The cable railway companies have met their own needs by building tunnels under the river; but the long or steep grades required to make the necessary descent from the street levels on either side of the river make such a solution of the problem out of the question for ordinary street traffic.

In the quest for a type of drawbridge which should obviate the defects of the swing span, many engineers and inventors have expended much thought and ingenuity, and at least four different types of structure have been actually built and put in operation, all of which have been illustrated and described in our columns. The first of these was invented by Mr. Wm. Harman, Manager of the Chicago Towing Co., and a bridge from his designs was built by Shailer & Schniglau, of Chicago, at Weed St., and was opened for traffic on May 23, 1891 (Eng. News, May 23, 1891). A second bridge of the same type, but with some improvements, was built by the same contractors at Canal St., in 1893 (Eng. News, Dec. 14, 1893). These bridges were of the folding floor type. An entirely different solution was the straight lift bridge designed by Mr. J. A. Waddell for the Halsted St. crossing, and completed in the spring of 1894 (Eng. News, April 19, 1894). A type of structure of greater novelty than either of the preceding is the rolling lift bridge invented by the late Wm. Scherzer. The first bridge of this type was built in 1893, to carry the Metropolitan Elevated R. R. across the river, and the second one, just completed by the city of Chicago at Van Buren St., was illustrated in our issue of Feb. 21.

On our inset sheet in the present issue we show still another type of lift bridge, the invention of Mr. Max. G. Schinke, Asst. City Engineer of Milwaukee, and built for that city by the Wisconsin Bridge & Iron Co. This bridge is designed for a much narrower channel than the Chicago River bridges, but is quite as interesting in its design. A novel detail of the bridge deserving especial notice is the use of a roller bearing on the axle of the 18-in. wheel which carries the rear end of the moving span. The axle of this wheel is surrounded by 19 rollers of the style made by the Hyatt Roller Bearing Co. (Eng. News, Feb. 1, 1894), each roller being 1 in. in diameter and 6 ins. in length. Such a construction should apparently enable the bridge to be moved with very small expenditure of power. The structure as a whole will certainly be examined with much interest by every one interested in bridge design.

STATE REGULATION AND VALUATION OF RAILWAYS IN TEXAS.

As the various sections of the country become well provided with railway communication, there comes a growing recognition of the wisdom of state regulation and restriction of the establishment of new lines, so as to avoid the construction of roads built by speculative promoters, with little regard to the real needs of the country, and also to avoid the building of rival lines in a territory which can produce barely traffic enough to support one.

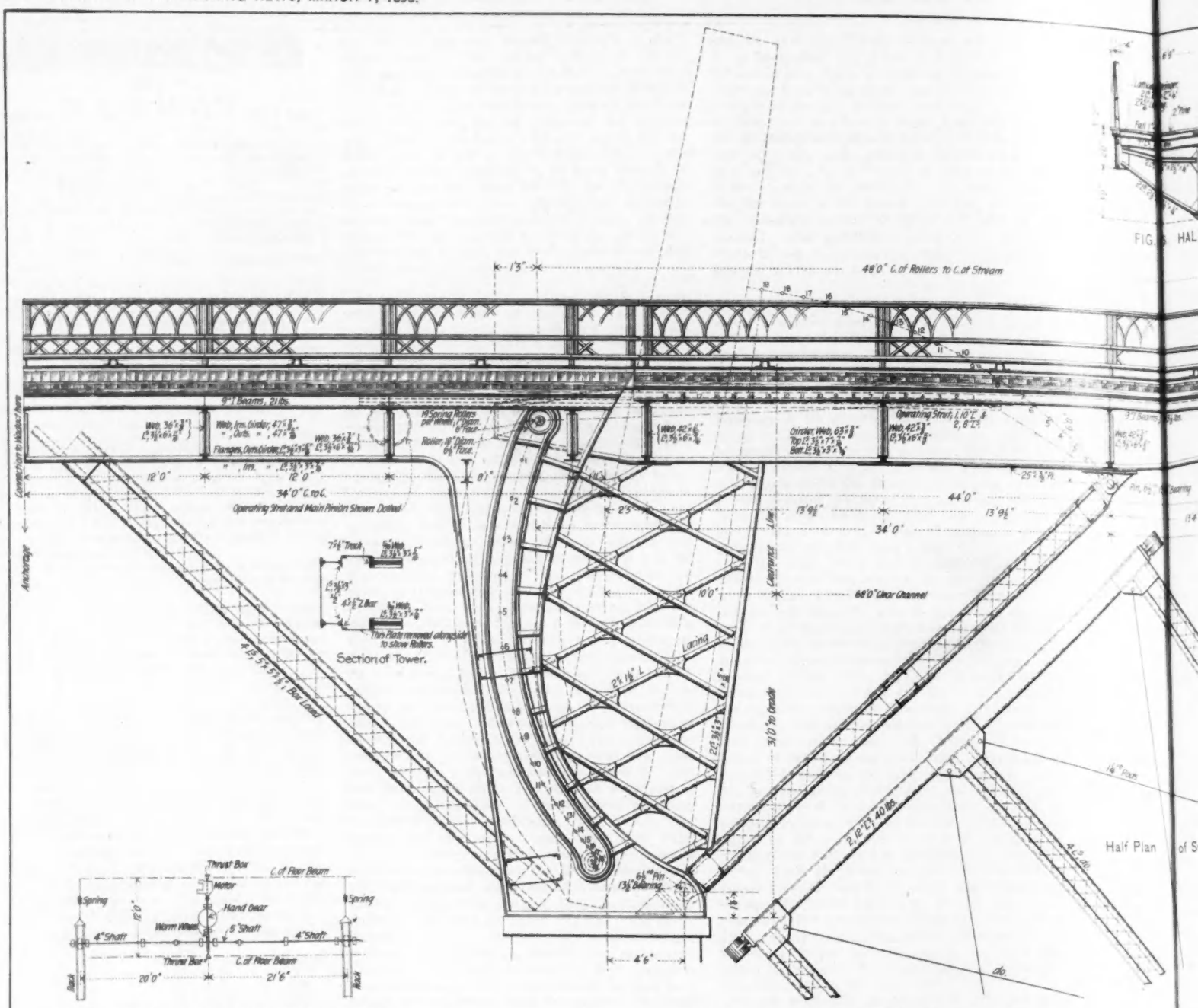


FIG. 4. SECTIONAL ELEVATION OF HALF SPAN.

FIG. 8. DIAGRAM OF OPERATING MACHINERY.

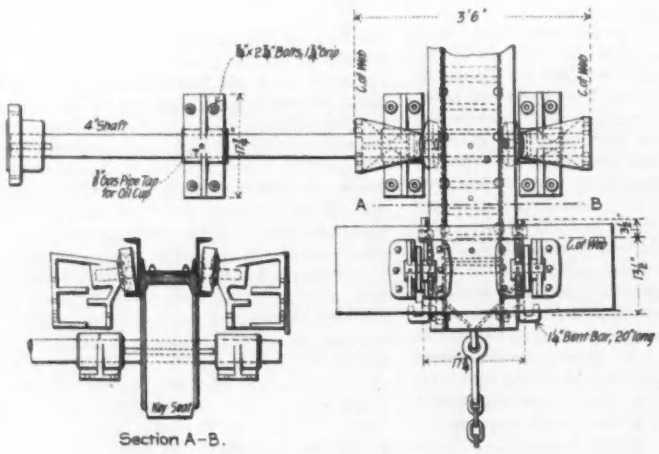


FIG. 10. SECTION AND PLAN OF OPERATING STRUT.

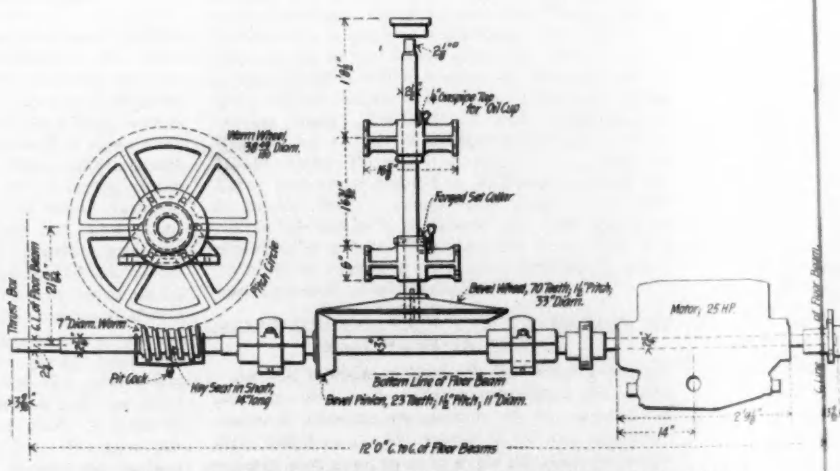

Worm Wheel
7" Diam. Worm
Key Seat in Shaft
Bevel Pinion, 23 Teeth; 1½" Pitch, 11" Diam.
Bottom Line of Floor Beam
Motor; 25 HP.
12'0" c. to c. of Floor Beams

FIG. 9. SIDE ELEVATION OF MOTOR AND HAND TURNING GEAR SHOWING CONNECTIONS TO WORM WHEEL.

FOLDING DRAW SPAN OF SIXTEENT

Geo. H. Benzenberg, M. Am. Soc. C. E., City Engineer of Milwaukee. Max G. Schm

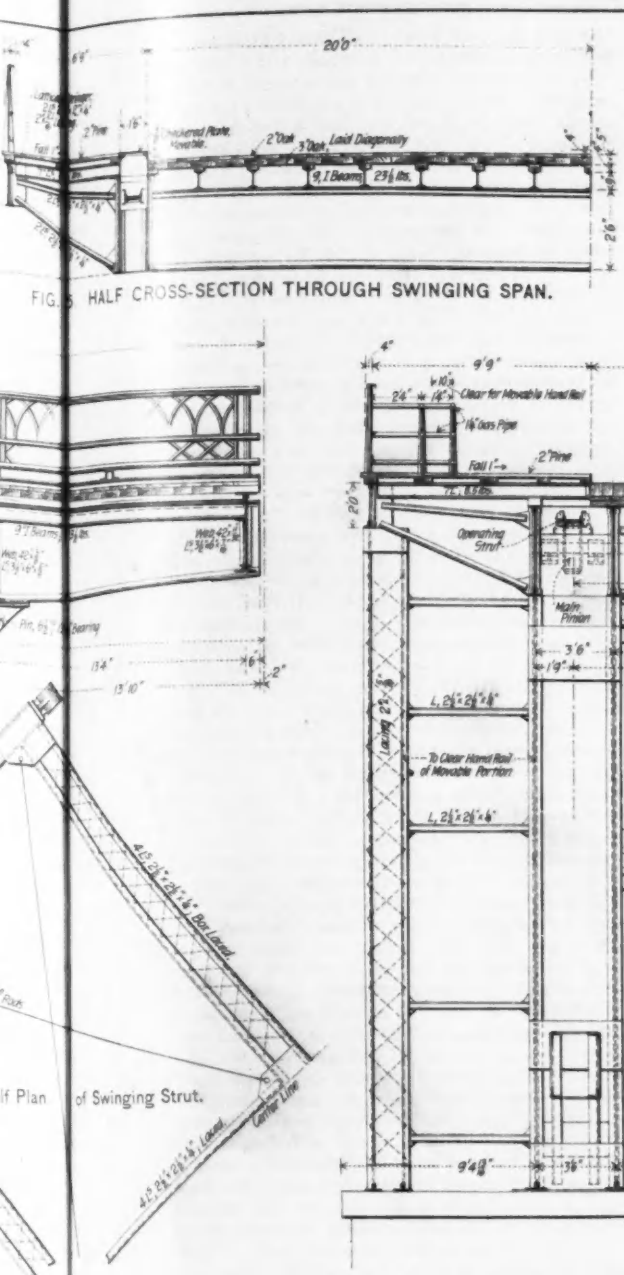


FIG. 6. HALF CROSS SECTION THROUGH STATIONARY SPAN, SHOWING POSITION OF OPERATING MACHINERY.

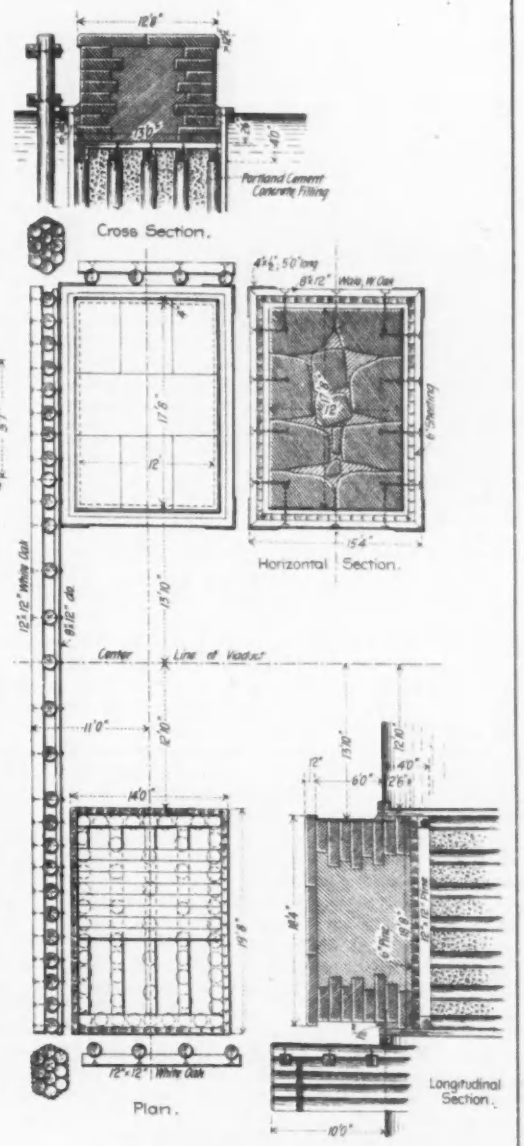


FIG. 2. DETAILS OF RIVER PIERS AND FENDER PILES.

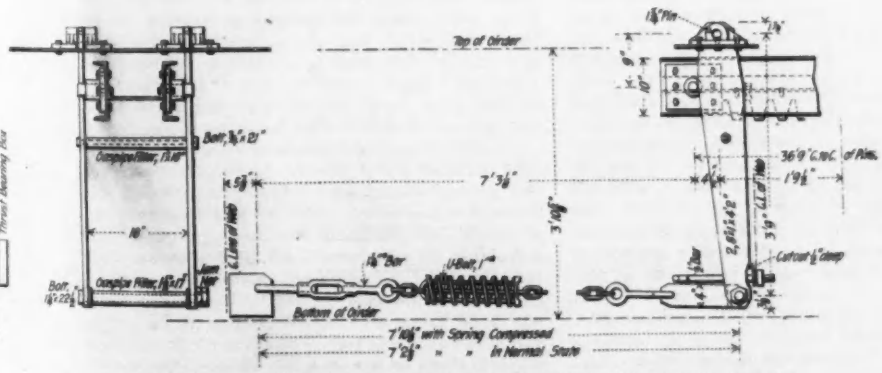


FIG. 11. CUSHIONED CONNECTIONS BETWEEN OPERATING STRUT AND MOVING GIRDER.

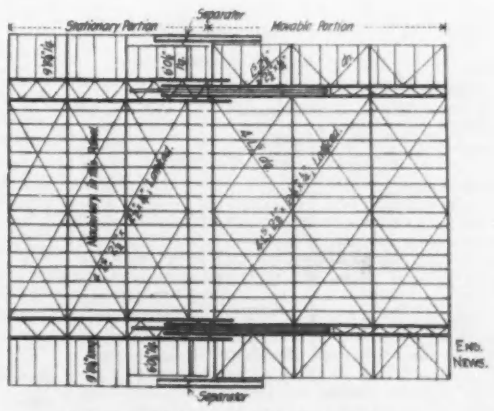


FIG. 7. PLAN OF FLOOR SYSTEM SHOWING LATERAL BRACING.

TEENTH ST. VIADUCT, MILWAUKEE, WIS.

G. Schinke, Ass't. City Engineer, Patentee. The Wisconsin Bridge & Iron Co., Contractors.

CHAS. HART & SONS, LITH., 88 VESEY ST., N. Y.

Massachusetts and Maine were the first states to undertake the regulation of railway construction, and now Texas, which has been regarded as a state that has changed from the one extreme of presenting subsidies of land and bonds to every wildcat railway scheme promoted, to the opposite extreme of granger restrictive legislation, has, as a matter of fact, adopted a system of railway regulation which is worth careful and unprejudiced study. The Texas law makes the issue of stock and bonds subject to the approval of the Railroad Commission, under rules laid down by legislative enactments.

The law controlling this matter was enacted in April, 1893, and was a new step in railway legislation. It declares that "the power and authority of issuing or executing bonds, or other evidences of debt, and all kinds of stock and shares thereof, and the execution of all liens and mortgages by railway companies in this state, are special privileges and franchises, the right of supervision, regulation, restriction and control of which has always been, is now, and shall continue to be vested in the state government." It also provides that no bonds or other indebtedness shall be issued and secured by a lien or mortgage on any railways over and above the reasonable value of the property of the railway, and makes it the duty of the Railroad Commission to ascertain the value of each railway in the state, including its franchises, appurtenances and property. This law, therefore, charged the commission with two important duties: 1, to ascertain and record the value of all existing roads; and, 2, to limit the issue of stocks and bonds in the aggregate to the cost of construction on all roads thereafter built. The report of the Railroad Commission for 1894 states that, while this law was at first regarded by many as being prejudicial to further railway construction, it is now generally regarded as one of the most salutary laws of the state, and that capitalists who understand its provisions regard it with favor. It vests large discretionary powers in the Commission, and its success depends in a great measure upon the faithfulness with which the spirit and purpose of the law are adhered to in its administration. Since the passage of this law the Commission has granted authority to different railway companies to issue bonds amounting to $5,429,520 and covering 361 miles of railway; while bonds have been approved amounting to $906,000 and representing 136 miles. The difference between authorizing and approving the bonds is explained further on. The law is a decided bar to wildcat railway enterprises, and is an evidence of the wise tendency of the authorities in several states to thus regulate and control railway construction as soon as the country is settled up and railway competition begins. The Commission points out that its duty is to regard a railway as a common carrier, and from that point of view the granting of authority to issue bonds on a new enterprise must be decided by a consideration of the question as to whether it will pay, and it is obvious that many other considerations besides these of mere physical cost enter into this question. For instance, the plan and profile submitted to the Commission may show that heavy and expensive works will be required, but the line may be located in districts entirely devoid of traffic, either present or immediately prospective, or it may be laid out with grades and curves that would preclude the possibility of profitable operation in competition with lines of better design. Such projects would naturally be considered, as a rule, as being mainly promoted with a view to reaping profits from the work of construction, rather than from legitimate operation. These facts, together with the questions of relative resistance to traction and the increased cost of maintenance and equipment due to heavy grades and curvature, etc., would be duly considered by the Commission in connection with any application for authority to issue bonds for a new railway. The Commission, in its report, states, as its opinion, which is borne out by all the statistics in its possession, that the railways of the state should be built with a maximum grade of 1 per cent., properly compensated for curvature, exceptions being so few as simply to prove the general rule, and states that many freight divisions of roads that would otherwise be operated at a greater profit, are subjected to serious diminution of earning capacity by the unnecessary introduction of grades of 1.25 per cent.

Under this law the first step in the process of issuing bonds is to secure the authority of the Commission, and the second step is to secure their approval by the Commission and their registration in the office of the Secretary of State; but it does not follow that because the authority has been given in the first place, the approval will be given in the second case. The bonds are authorized to be issued on the basis of the cost of constructing a railway of a certain grade with a certain kind of material and of a certain standard of excellency, so that if, when the bonds are presented for approval, the Commission is satisfied (after examination) that the road has not been completed in good faith, in accordance with the statements which formed the basis upon which the issue of the bonds was authorized, then they will not be approved and registered. This may seem to be likely to deter promoters and financiers from entering into railway projects, but, as a matter of fact, it will deter only those who are either irresponsible or are merely desirous of building a line for the money to be made out of its construction, without regard to the public necessity of or traffic possibilities of the line. The Commission claims that such action cannot result in harm to any one, or operate as an impediment to railway construction, as it guarantees that the bond issue is on an honest basis, and that the property actually exists upon which the bonds become a lien at the time of their approval and registration.

To insure uniformity of action in all cases, as well as a strict compliance with the law, the Commission prescribes a certain method of procedure to be followed in applications for authority to issue bonds. In the first place, the company must submit a copy of its charter, the notice to stockholders of the meeting to authorize the directors to issue bonds, and the resolutions passed at such meeting; the contract with the construction company proposing to build the road, the extent and value of work already done or in process of completion, particulars of donations of money and property, the aggregate amount of stock subscribed to the capital of the company, and a list of subscribers with statement of stock represented and the amount of cash, labor or property paid thereon. Besides these financial details, the company must submit the following: 1, a map of the alinement, on a scale of not less than 2,000 ft. to the inch, showing property, city and county lines (any changes in the located line made before or during construction must be reported, awaiting the final action of the Commission); 2, deeds to right of way and other real estate acquired for railway purposes; 3, maps of station grounds, yards and terminals, on a scale of not less than 200 ft. to the inch, showing locations of tracks, buildings and structures, and their relation to the streets, blocks and lots, if situated in a town or city; 4, profile of located or completed road or part of road, on a scale of not less than 400 ft. to the inch horizontal and 30 ft. to the inch vertical, showing the nature of timber on right of way, the quantities of excavation and embankment and their classification, location and length of sidings and spurs, location of water stations and nature of supply, and also the location of all bridges, buildings and other way structures; 5, plans and specifications for grading, ballast and track, bridges, buildings, and other standard structures; 6, statements of number and class of locomotives, cars and miscellaneous equipment; 7, detailed estimate of the cost of the proposed or completed road. Upon the filing of such application and a full compliance with the law, the Commission will issue an order granting the corporation authority to issue its bonds to become a first lien on its franchises, property, etc., to the extent of the value thereof, as ascertained by the Commission.

The subsequent application to the Commission to approve the bonds and have them registered must state, under oath of the president of the company, the amount of stock, the amount of outstanding bonds and the number of miles of completed road, or part of road, upon which the bonds are to become a first mortgage. The Commission will then direct its engineer to inspect the road and ascertain if it has been constructed and equipped in accordance with the plans, profiles and specifications originally submitted, and if this shows that the road has been thus constructed in good faith, an order will be issued directing the Secretary of State to register the lands. No bonds will be approved and registered, except upon roads completed and equipped, and then only to the amount of the value thereof, as ascertained by the Commission.

The work of railway valuation undertaken under this law was discussed in our issue of April 12, 1894, at which time the property of one road had been appraised, and showed an average of $17,060 per mile. In the report of the Railroad Commission for the year ending Dec. 31, 1894, it is shown that 21 railways, aggregating 5,888 miles, have been appraised out of a total of 43 roads and 9,138 miles in the state. The values range from $6,883 to $34,326 per mile, and average $15,926 per mile, while the aggregate for the 5,888 miles is $93,785,160. This work has been conducted with much care and detail, under the direction of an engineer, and the valuations on file deal with each mile and every item of construction of each mile, as actually checked on the ground by the experts, and the basis of the valuation made by the Commission has been the present cost of reproducing the physical properties of the roads in question. A corroboration of this approximate average valuation is afforded by the report of the Industrial Commerce Commission for 1891, in which is given a table of values for the several groups of railways, based on the capitalization of their net earnings at 5%. The value there given for Group IX., which includes Texas, Louisiana and a portion of New Mexico, is $14,089 per mile. The average value for Texas will be reduced by the valuations made during the present year, as the most expensive lines have already been dealt with, and the lower prices now ruling for materials and construction work would, of course, enable the road to be built at the present time at a lower cost than under the higher prices ruling when the road was originally constructed. The Board calls attention to the wide differences that have been observed between the reports of value made by the officers of the railway companies for the purposes of taxation, and the reports of cost embodied in the statements sent in by them to the Commission, and suggests that, in justice to the railways and the state, some method of equitably adjusting these figures over the entire mileage is extremely desirable.

It will be seen that the work of valuation is being undertaken comprehensively and systematically, and under proper management, and its results cannot but be beneficial to the railways as well as to the state as it no doubt has an effect in inducing the companies to maintain their property in good condition. This fact, together with the protection against wildcat railway enterprise and speculation, which is afforded by the state control of bond issues, make this Texas act one of the most important pieces of railway legislation ever put in force in this country.

LETTERS TO THE EDITOR.

THE TEXAS STOCK AND BOND LAW.

Sir: I send you a copy of the third annual report of the Railroad Commission of Texas, and, in addition to the discussion of rates and the statistics of traffic and operating expenses, I wish to call your attention to the regulations adopted for the issuance of stocks and bonds and the valuation of existing railway property prepared by the commission. It has always seemed to me, from a knowledge of the state during nearly 15 years, that the stock and bond law of Texas is an exceedingly wholesome piece of legislation, alike beneficial to the public and the bona fide railway investor.

Notwithstanding the commercial depression, there are several healthy railway projects under way in this state, and the traffic throughout our eastern and central districts will be seen to be sufficient to justify any honest expenditure of capital. Indeed, the mere fact of the roads meeting their present obligations guarantees a handsome return from any investments based upon a reasonable approximation to the principle of getting a dollar's worth of railway for a dollar. The interested and ridiculous cry that legislation in the state is oppressive to corporations or capital is well answered by the fact of the donation of 38,000,-

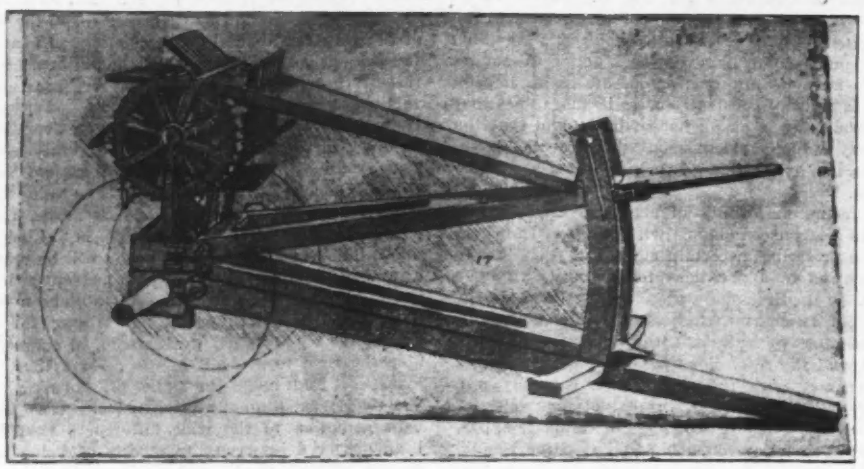
000 acres of land to former enterprises, and the further complaisance of the state in accepting renditions for taxation of railways which vary in the ratio of from one-third to one-seventh of the sum of their stocks and bonds. The continued liberality of citizens in the matter of right-of-way and donations to projects of this kind is a matter of common knowledge. Yours truly,

C. Corner,
Assoc. M. Inst. C. E., Expert Civil Engineer, Railroad Commission of Texas.
Austin, Tex., Feb. 22, 1895.

(The state control of bond issues in Texas, and the consequent protection against merely speculative railway projects, is an important matter which is probably not familiar to many of our readers, and we have, therefore, discussed it at some length in our editorial columns.—Ed.)

A MECHANICAL ENIGMA.

Sir: Leonardo da Vinci, who died in 1519, left about 5,000 pages of manuscript and drawings, which are now being edited and published. Among these are several hundred mechanical devices, some of which are explained by the writings of the master, while



WHAT IS IT?

others are quite comprehensible in themselves, and still others are enigmas.

Although not all of these drawings can be traced with certainty to the hand of Leonardo, yet they are all of great interest, as showing the condition of mechanical science four centuries ago.

So far as I can learn, these mechanical drawings have never been submitted to the critical examination of a large number of experts. It has occurred to me that they may interest your readers, and that from them valuable information may be drawn. I send, herewith a photograph of one of these drawings, for the benefit of any who may enjoy mechanical puzzles of this sort. Can any of your readers answer the question, what is it?

Yours truly, James Means.
196 Beacon St., Boston, Mass., Jan. 15, 1895.

(We reproduce herewith the photograph sent by Mr. Means. Any of our readers who may exercise their guessing powers upon it are expressly requested to send their communications direct to Mr. Means and not to the editors of this journal.—Ed.)

SETTLEMENT OF BUILDINGS IN THE CITY OF MEXICO.

Sir: In reply to the query concerning excessive settlement of large buildings, I would mention the City of Mexico as a place where very general settlement of buildings has taken place. The School of Mines, a large building built by the famous architect Tolsa, and occupying a whole block of frontage, has settled seriously and also unevenly (most toward the rear), and the line of the cornice shows a very marked downward curve. A line drawn from the front of the building toward the rear and to the front of the building facing the other way, would show the excess of sinkage of the back part of the two buildings over the front to be 2 or 3 ft. Still they do not appear to have suffered much damage.

The cathedral, 200 ft. × 400 ft. and very massive, shows signs of sinking, as its water table inclines downward toward that of the large chapel adjoining. Many cracks have appeared in the vicinity of the dome, which itself has a large crack throughout. These cracks have been plastered up from time to time, but they are not considered of any consequence, even if they are still opening, and they opened noticeably in the earthquake of Nov. 2, which did so much damage in the city. Pits for the foundations are said to have been excavated to a depth of 15 ft., when the ground was driven as full as possible of stakes 6 ft. long, which were then capped with cypress planks to receive the masonry.

The church of San Hypolito and the church in San Francisco St. are also examples of sinking. The towers of the latter church were evidently built later than the main building, as they are vertical and do not have the inclination of the latter.

The terminal station of the Mexican Ry. settled so much on one side as to cause fears for its safety. I am told that a pile driver was employed for a period of over a month to cause equal settlement of the other side and was partially successful.

The only place where I saw foundations being put in was at the new terminal station of the National Ry., where excavation was carried down about 2 meters, where a kind of stone or cement gravel called "tepetate" was encountered. This was said to extend to some depth and to have no soft stratum beneath. The foundations were, however, made 9 ft. in width, reduced uniformly to 3 ft. at the water table, which, if the above statement be true, seems excessive. Water at the lake-level was encountered 3 ft. below the surface, the material excavated being black soil with clayey silt beneath. Detailed statements of settlement of buildings in the City of Mexico from some one more fully informed might be of interest to you. Very truly yours, W. B. Wright.
New Orleans, La., Feb. 21, 1895.

TEST OF A NEW DESIGN OF ELECTRIC RAILWAY POWER STATION.

(Continued from page 151.)

But besides this factor, we must call into the account the prices demanded for fuel and labor in the district in which the station is situated; capacity of plant; not to mention value of real estate, as compared with ground space necessary per horse-power, which we have not considered. In this latter respect, the station would make a better showing in a thickly populated district than where it really is, the ground space per horse-power of the whole plant being only about 5 sq. ft.

It is not pretended by the authors that in the results here given will be found everything which may be desired or desirable. Many interesting quantities might have been ascertained—such, for instance, as water used by the condenser, temperature of flue gases before entering economizer, wet and dry weather economy, etc.—which, as a matter of fact, were left untouched, it being believed that the results already given would of themselves be of sufficient value to serve as a guide in regard to the merits of the station.

In conclusion, we owe our thanks, which we hereby express, to a number of gentlemen, Messrs. G. B. Bradley, H. H. Murray, F. C. Spencer, L. P. Wheeler and C. C. Wilson, graduates of the Sheffield Scientific School, as well as to Messrs. G. P. Hodgman and S. H. Conner, of Hoboken, N. J., for their very efficient assistance in taking observations; to Prof. F. A. Gooch, Ph. D., and Mr. E. H. Lockwood, M. E., Ph. B., of Yale University, for kindly assistance, theoretical and practical; to the Bristol Manufacturing Co. for the loan of their useful and interesting recording instruments; to Messrs. Westinghouse, Church, Kerr & Co., for the promptness and alacrity they have shown us in furnishing all necessary information; to the Westinghouse Machine Co., for the loan of indicator rigs; and especially to the faculty of Stevens Institute, and to the Winchester Ave. R. R. Co. for free permission of publication of the results of these tests as herein set forth.
Stevens Institute of Technology, Sept. 1, 1894.

THE PROPOSED BOSTON METROPOLITAN WATER SUPPLY.

Another progressive step in sanitary affairs and municipal improvements is marked by a special report of the Massachusetts State Board of Health, recently submitted to the legislature of that state, and the introduction of a bill to carry out the recommendations of the report. Having provided a metropolitan sewerage system for Boston and 17 surrounding municipalities, it is now proposed to furnish a metropolitan water supply for the 27 cities and towns within ten miles of the Boston city hall, and the town of Swampscott, outside this limit. The following description of this important enterprise has been compiled from advance pages of the report, which has recently been submitted to the Massachusetts legislature.

The population, within a ten-mile radius from the Boston city hall, was 844,814 by the census of 1890, while the estimated population for 1895 is 984,301, and for 1898, 1,082,539. The figures for 1898 are given because this is the earliest possible date at which a metropolitan supply can be made available. The several municipalities, and their populations for the years named, are given in Table I. The sewage of the 18 places marked by asterisks in the table, discharges, or will eventually discharge to the ocean through two main outlet sewers. The Metropolitan Sewerage Commission has built one of these outlet sewers, discharging at Deer Island (see accompanying map for location of island), which serves 13 cities and towns and a part of Boston. It also built a main sewer, which serves four cities and towns (Brookline, Newton, Waltham and Watertown) and a part of Boston, and connects with the Boston intercepting sewers, which discharge at Moon Island. The sewers provided by the Metropolitan Sewerage Commissioners serve a territory having by the census of 1890 a population of 395,426, of which 107,210 were within the Boston city limits. The two ocean outlets, however, serve actually or potentially 736,693 of the 844,814 people within the proposed Metropolitan Water District, in 1890, and, perhaps, more of the district will yet connect with the outfall sewers:*

TABLE I.—Cities and Towns in the Proposed Metropolitan Water Supply District, with Population in 1890 and Estimated Populations in 1895 and 1898:

City or town.	Population in 1890.	Estimated population in — 1895.	1898.
*Boston	448,477	504,702	541,532
*Cambridge	70,028	80,917	87,807
Lynn	55,727	61,146	67,982
*Somerville	40,152	51,583	58,658
*Chelsea	27,909	30,975	32,850
*Newton	24,379	28,470	32,809
*Malden	23,031	30,240	33,196
*Waltham	18,707	21,700	23,509
Quincy	16,723	22,140	26,152
*Woburn	13,499	14,701	15,962
*Brookline	12,103	15,638	17,913
*Medford	11,079	14,812	17,685
*Everett	11,068	17,750	21,920
Hyde Park	10,193	12,300	13,740
*Melrose	8,519	11,656	13,677
*Watertown	7,073	7,551	8,420
Wakefield	6,982	8,119	8,998
*Stoneham	6,155	7,072	7,704
Revere	5,668	7,707	9,461
*Arlington	5,629	6,573	7,519
*Winchester	4,861	6,930	7,782
Milton	4,278	5,800	6,730
Saugus	3,673	4,638	5,290
Lexington	3,197	3,645	4,104
*Winthrop	2,726	3,783	4,691
*Belmont	2,098	2,628	3,256
Nahant	880	1,125	1,293
Total, 27 cities and towns.	844,814	984,301	1,082,539

* These places, with the exception of a large part of Boston, are also served by the metropolitan sewerage system.

The final investigations and recommendations, upon which the Massachusetts legislature based its bill providing for the Metropolitan Sewerage Com-

* The Metropolitan Sewerage System was described and illustrated in detail in our issues of Jan. 25, Feb. 8, May 3, 10 and 17, 1894.

TABLE II.—Comparison of Amount of Water in Gallons Consumed in the Metropolitan District, with the Present Capacity of the Sources of Supply.

City or town.	Average daily consumption. 1890. 1 = 1,000	1894.	Estimated average daily consumption, 1898. 1 = 1,000.	Ave. daily capacity of sources.*
Boston (Cochituate works)	33,872	46,376	59,280	48,000
Charlestown, Somerville, Chelsea and Everett (Mystic works)	8,301	10,282	12,263	7,000
Cambridge	4,565	5,777	6,988	7,200
Lynn and Saugus	2,657	4,020	5,383	3,450
Newton	985	1,623	2,261	2,000
Malden	*	1,460	1,800	1,520
Waltham	626	1,237	1,848	3,100
Quincy	497	708	1,099	840
Hyde Park and Milton	391	587	783	600
Woburn	777	972	1,167	1,000
Wakefield and Stoneham	537	*	800	660
Brookline	877	1,325	1,779	3,100
Medford	*	699	950	900
Revere and Winthrop	427	774	1,121	800
Melrose	581	681	781	800
Watertown and Belmont	360	414	468	550
Arlington	*	*	450	750
Winchester	*	*	430	900
Swampscott and Nahant	229	324	419	300
Lexington	*	*	190	230
Total	55,683	77,549	...	...
Estimated consumption in places marked with an asterisk	2,135	1,497	...	...
Tot'l, metropolitan district.	57,818	79,046	100,026	83,700

* Capacity in very dry years of the several works as they existed in 1894.

mission, were made by the State Board of Health, after earlier studies in the same field. The value of these investigations has been so great that, in taking up a water supply for "Greater Boston," the first step of the legislature was to instruct the State Board of Health to investigate the subject and report to it. The law providing for this investigation was a model of its kind, both in scope and brevity, and as the initiative in this line in other states will often have to be taken by engineers, we quote the text of the law in full, as follows:

Sec. 1. The state board of health is hereby authorized and directed to investigate, consider and report upon the question of a water supply for the city of Boston and its suburbs within a radius of ten miles from the state house, and for such other cities and towns as in its opinion should be included in connection therewith.

Sec. 2. The said board shall forthwith proceed to investigate and consider this subject, including all questions relating to the quantity of water to be obtained from available sources, its quality, the best methods of protecting the purity of the water, the construction, operation and maintenance of works for storing, conveying or purifying the water, the cost of the same, the damages to property, and all other matters pertaining to the subject.

Sec. 3. The said board shall have power to employ such engineering and other assistance and to incur such expenses as may be necessary for carrying out the provisions of this act.

Sec. 4. The said board shall report fully with plans and estimates to the legislature on or before the first Wednesday in January in the year 1895, and shall append to its report drafts of bills intended to accomplish the recommendations of the board.

Sec. 5. The total amount of money which shall be expended out of the treasury of the commonwealth in carrying out the provisions of this act shall not exceed $40,000. The commonwealth shall be reimbursed for the amount expended by the cities and towns which are to receive the benefit of the system recommended in the report, in proportion to the population of each.

Sec. 6. Before incurring any expense the board shall from time to time estimate the amounts required and shall submit the same to the governor and council for their approval, and no expense shall be incurred beyond the amount so estimated and approved.

Sec. 7. This act shall take effect upon its passage. (Approved June 9, 1893.)

To the appropriation of $40,000 there was added afterwards $2,500, and the date for making the final report was extended to Feb. 6, 1895. About $30,000 of the appropriation was expended for salaries, about $7,000 for labor in making borings and sinking test pits, and nearly $2,000 for boring apparatus and repairs.

On July 6, 1893, the Committee on Water Supply and Sewerage of the State Board of Health, of which Mr. Hiram F. Mills is chairman, instructed Mr. P. F. Stearns, M. Am. Soc. C. E., Chief Engineer of the Board, to take charge of the investigations, under the supervision of the committee. Mr. Thos. F. Richardson, M. Am. Soc. C. E., was appointed as principal assistant to Mr. Stearns in this work, and nine other assistants were employed during the investigation, including Mr. X. H. Goodnough, who has long been a member of the regular engineering force of the Board. Messrs. Jos. P. Davis, Desmond Fitz Gerald and Dexter Brackett, all members of the American Society of Civil Engineers, took part in the investigation, as did also Prof. T. M. Drown and Mr. Allen Hazen, the latter giving advice in regard to purification of the Merrimac River water by sand filtration. Mr. Chas. T. Main, of the firm of Dean & Main, Boston, was engaged as an expert on mill values.

The first questions to be decided were the present consumption and available water supplies of the district and the future population and consumption for which provision must be made. Table II. shows the present consumption and supplies in gallons, and Table III. the estimated populations, daily consumption per inhabitant and total daily consumption for 1895, and the end of each succeeding five-year period until 1930. The proper allowance of water per individual during the period named was deduced by Mr. Brackett, who has been intimately connected with the Boston waterworks for many years. Mr. Brackett's study of this subject is presented as an appendix to the report. From these two tables, it will be seen that the average daily consumption for the district, in 1894, was within less than 5,000,000 gallons of the dry-year capacity of the combined sources of supply now available; also that it is estimated that the daily per capita consumption will gradually increase from its present average of 85 gallons to 100 gallons, in 1930, when the population to be supplied is assumed as 2,521,875, giving a daily demand of over 250,000,000 gallons.

Mr. Stearns next takes up the general subject of ground and surface sources of water supply, making his remarks prefatory to the description of the present water supply of each city and town in the district. These descriptions occupy about 50 pages of the report, and further on statements are made for each municipality regarding the desirability of its entering the proposed district or obtaining its supply from independent works. The conclusions finally reached by the Board, on this latter point, were that works should be developed to serve the whole district, but that since the cities of Cambridge, Lynn, Newton, Waltham and Woburn, and the towns of Brookline, Lexington, Nahant, Saugus, Swampscott, and Winchester, containing in 1890 a population of 210,252, believe their present

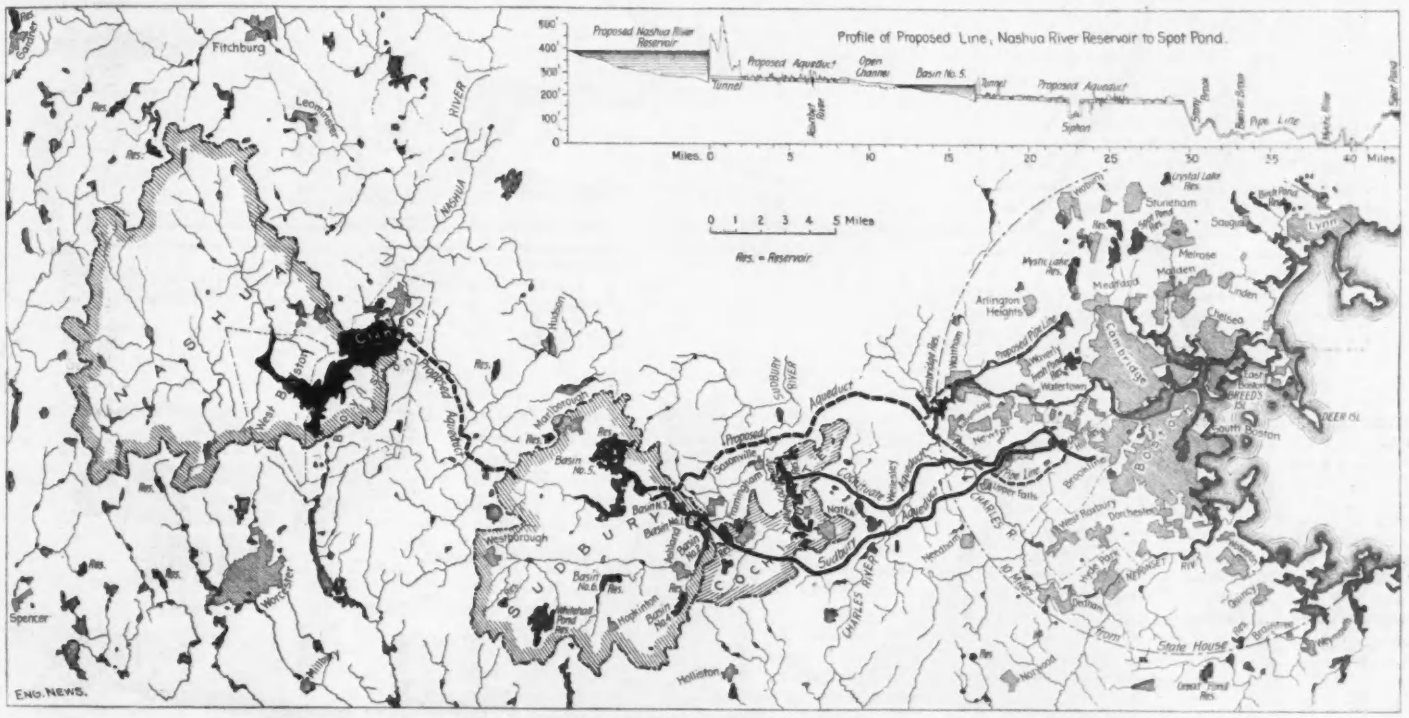


FIG. 1. MAP SHOWING PROPOSED BOSTON METROPOLITAN WATER SUPPLY.
F. P. Stearns, M, Am. Soc. C. E., Chief Engineer Massachusetts State Board of Health.

TABLE III.—Estimated Population and Consumption of Water in the Metropolitan District for Each Five Years from 1895 to 1930.

Year.	Estimated population.	Daily consumption, gallons. Per inhabitant.	Total.
1895	1,264,391	85	84,000,000
1900	1,148,033	90	103,000,000
1905	1,328,787	94	125,000,000
1910	1,526,624	97	148,000,000
1915	1,743,510	99	173,000,000
1920	1,979,930	100	198,000,000
1925	2,238,500	100	224,000,000
1930	2,521,875	100	252,000,000

TABLE IV.—Cost per Million Gallons of Water Stored in Other Reservoirs Compared with the Proposed Nashua Reservoir:

City.	Name of reservoir.	Acres flowed.	Storage, in million gallons.	Cost per million gallons.
Boston	Reservoir, No. 1	143	280	$918
"	" No. 2	134	530	879
"	" No. 3	253	1,080	388
"	" No. 4	167	1,400	591
"	" No. 6	185	1,530	536
"	" No. 5	1,229	7,438	*336
Cambridge	Proposed reservoir on Hobbs Brook**	350	1,500	400
	Proposed reservoir on Nashua River	4,195	63,068	144

* Based upon estimated cost of reservoir.
** The figures for this reservoir are based upon preliminary estimates of cost and capacity, as given in the annual report of the Cambridge Water Board for 1893.

supplies to be sufficient for some years to come, they need not be provided with water from the Metropolitan system until they desire.

In determining upon the most available source of supply for the district, Mr. Stearns examined all the larger watersheds in Massachusetts, east of the Berkshire hills, as well as the most prominent watersheds in the adjoining states, on the north. The three sources most worthy of careful investigation were the South Branch of the Nashua River, at a point above Clinton, the Merrimac River, above Lowell, and Lake Winnipiseogee in New Hampshire. The latter source is 77 miles in an air line from the State House. The cost of a conduit from this lake and of distributing the water through the district would be $34,000,000, in addition to which there would be damages for diverting the water, and it is by no means certain that the state of New Hampshire would allow the water to be taken into another state. Moreover, the Board concludes, the water thus obtained would be no better than that available at less expense within the borders of Massachusetts.

The Merrimac River source would be within 25 miles of the State House, and the supply would be unlimited, but the eight largest cities and towns upon the river, above this source, had a population in 1890 of 130,399, and the water could not be used without filtration. The cost of purification and of conveying the water to the district would be $17,500,000, and it was concluded to be advisable to pay some 10% more for a supply originally unpolluted.

For a little over $19,000,000 it is estimated that an eminently suitable supply can be secured from the South Branch of the Nashua River (see Fig. 1), directly in line with the present aqueducts, the carrying capacities of which are above the yield of their watersheds. In addition, further to the west than the Nashua River source streams at a higher elevation are available, which could be added one after another, as required, thus increasing the supply almost indefinitely. This watershed is, therefore, recommended by the Board for adoption, and plans for its development are presented in detail. The map, Fig. 1, has been redrawn from the report with the omission of some details not directly related to the scheme.

A dam across the river is recommended, which would raise the water 107 ft. above the present mill pond, flood 6.56 sq. miles to an average depth of 46 ft., making the largest body of fresh water in Massachusetts, with a high water elevation 385 ft. above high tide in Boston harbor. The reservoir would have a capacity of 63,000,000,000 gallons, and would make available, with the natural flow of the stream, a daily supply of 111,000,000 gallons during a series of dry years. It is proposed to utilize 62,000,000 gallons from the present Sudbury and Cochituate sources, which, with the new supply, would make a total of 173,000,000 gallons of water available, or double the combined capacity of the present sources of the district. As has been said, this supply can be increased by future extensions to the west. Aside from this reservoir, the principal features of the scheme, which can be better understood by referring to the accompanying map, Fig. 1, are thus stated in brief by Mr. Stearns:

An aqueduct capable of conveying 300,000,000 gallons of water per day from this reservoir to the Sudbury watershed.

The use of the present Sudbury and Cochituate aqueducts of the city of Boston for conveying water to Chestnut Hill Reservoir until their full capacity has been utilized.

An additional aqueduct, capable of conveying 250,000,000 gallons of water per day, to be built in the not distant future, for conveying water from Reservoir No. 5, of the Boston water-works, to the metropolitan district.

A low-lift pumping-station at Chestnut Hill Reservoir and a system of main pipes for supplying all of the lower portions of the metropolitan district until the aqueduct last mentioned is built, and afterward to supply to these portions of the district the water brought by the Sudbury and Cochituate aqueducts.

The use of Spot Pond in Stoneham as a low-service distributing reservoir.

The use of the present pumping-station (with enlargements—Ed.) at Chestnut Hill Reservoir and the construction of a new pumping-station in Malden, with corresponding main-pipe systems, for supplying respectively the southern and northern high-service districts.

Two small pumping stations and pipe systems for supplying water to comparatively small populations at a still higher level.

The drainage area tributary to the reservoir would be 118.23 sq. miles, having an average population of only 69 per sq. mile and yielding a remarkably satisfactory quality of water. It will be seen by looking at the map that the reservoir would flood large portions of the towns of Boylston and West Boylston, and these the most thickly-settled sections, having an assessed valuation of more than 50% of that of the whole of the two towns. The flooding would necessitate the building of new highways and the relocation of the Central Massachusetts Railway through nearly the whole length of the reservoir site. The entire estimated cost of constructing the reservoir is $9,105,000, but the cost per million gallons is low, as compared with the actual costs of five of the Boston reservoirs already built, and the estimated cost of another now under construction, and one contemplated by Cambridge, as is shown by Table IV.

Of the total estimated cost of $9,105,000, fully $4,000,000 is alloted to expenditures to insure the pure quality of water. The estimated cost of removing soil from the reservoir site is nearly $3,000,000, careful investigations having been made in this connection, including a large number of soil analyses by Professor Drown. The principal object of taking off the soil is to remove all organic matter from the reservoir bottom, and, consequently, the food for those minute organisms which impart disagreeable tastes and odors to stored water for the first few years after some reservoirs are constructed.

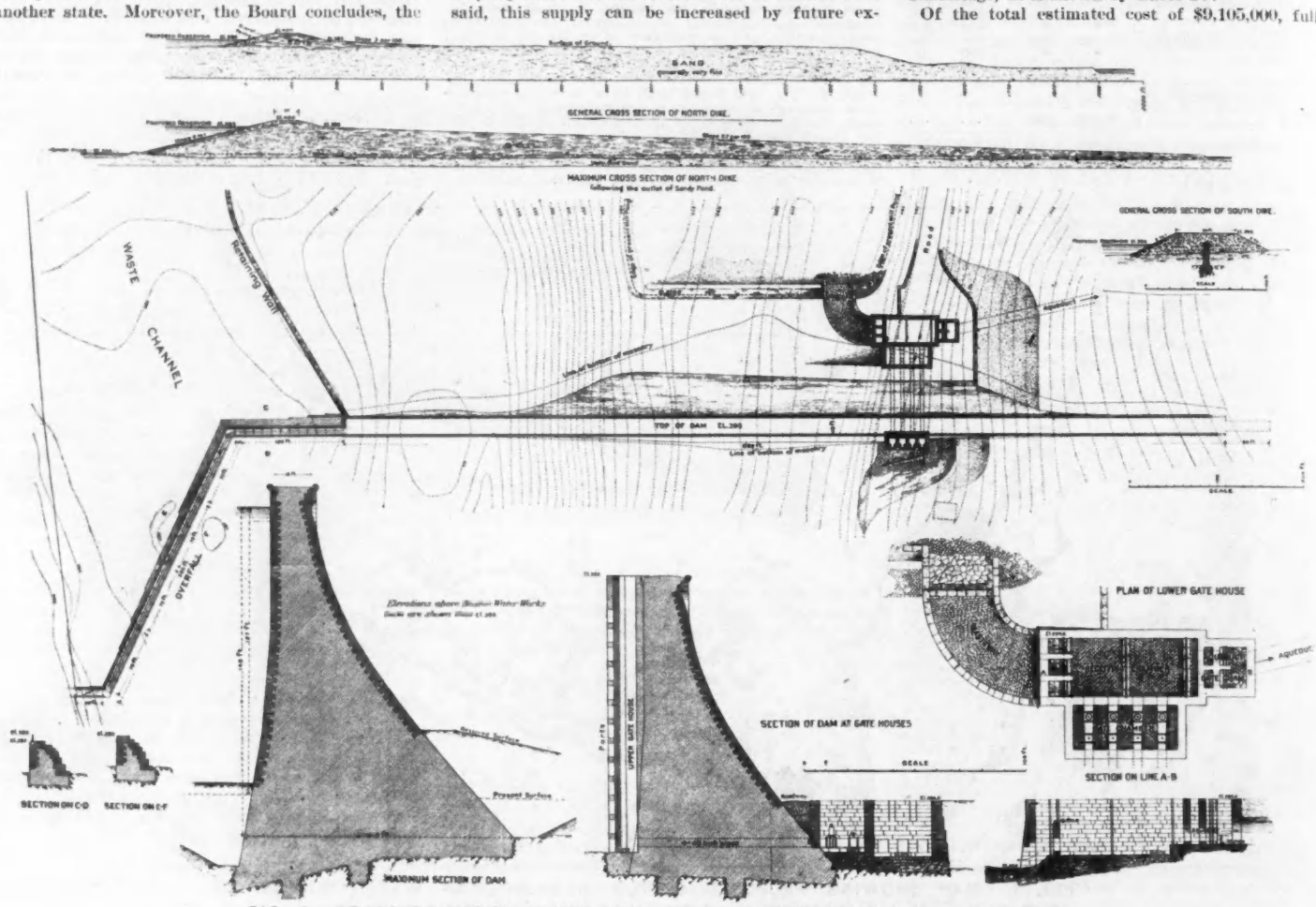

SAND
GENERAL CROSS SECTION OF NORTH DIKE.
MAXIMUM CROSS SECTION OF NORTH DIKE
following the outline of Sandy Pond.
GENERAL CROSS SECTION OF SOUTH DIKE.
WASTE CHANNEL
Retaining Wall
TOP OF DAM EL. 396
PLAN OF LOWER GATE HOUSE
SECTION ON LINE A-B
SECTION OF DAM AT GATE HOUSES
SECTION ON C-D
SECTION ON E-F
MAXIMUM SECTION OF DAM

FIG. 2 PROPOSED NASHUA RIVER DAM; BOSTON METROPOLITAN WATER SUPPLY.

The general character of the proposed reservoir dam is shown by Fig. 2, reproduced directly from the report. The cross-section of the main structure is similar to that of the New Croton dam,* now under construction for New York city. The total length of the main dam at the crest will be 1,250 ft., with a maximum height of 158 ft. to rock foundation at the down stream edge. The top of the dam will be 18 ft. thick and 10 ft. above high water. The masonry overfall, at the right in the plan in Fig. 2, would be 450 ft. long, 330 ft. being at the level of the full reservoir and 120 ft., being

3 ft. lower, with flood gates to raise this section to the full level. The overfall will discharge 8 ins. of rainfall on the whole watershed in 24 hours, without raising the reservoir level to an excessive height. In addition four 48-in. pipes, extending through the dam, will serve the joint purpose of discharging large quantities of water at times of freshet and of feeding the aqueduct when desired.

Extensive dikes of interesting construction are made necessary by the low ground adjoining the dam site. Cross-sections of these dikes are shown in Fig. 2. This part of the proposed work is so unique as to make it desirable to present Mr. Stearns's description of it, slightly abbreviated, as follows:

On the north side of the lower portion of the reservoir there is an extensive sandy plain, which has a general level about 15 ft. lower than the high-water level of the reservoir, and the water would flow out over it if not prevented by a dike. The plain contains some valleys and many bowl-shaped depressions, of which Sandy Pond is the largest.

After extended surveys and many borings it was concluded to locate the northerly dike as shown upon Plan No. 7 (not shown here—Ed.), and to construct it mainly of the soil taken from the reservoir, using the cross section shown upon Plan No. 8 (Fig. 2 in this article).

The borings, which ranged in depth from 16 to 175 ft. below the surface of the ground, showed that the

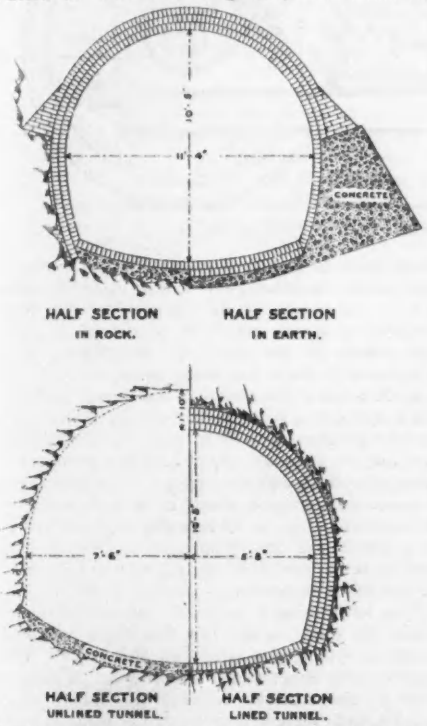


Fig. 3. Cross Section of the Proposed Nashua-Sudbury Aqueduct.

portion of the plain where the dike was finally located is composed mainly of very fine sand, which is nearly impervious to water; but, as already indicated by the great depth which the borings reached, the rock is so far below the surface that it would be impracticable to extend any cut-off wall down to it.

The impervious character of the material is well illustrated by the results found while making the boring 175 ft. deep. This boring was made at a point where the surface of the ground was 15 ft. above the ground-water level. The 2½-in. casing pipe was driven to a depth of 23 ft.; and the 1-in. wash pipe, with a stream of water from a hydrant flowing through it, was forced down 152 ft. farther. Notwithstanding the opportunity thus afforded for the water from the 1-in. pipe to percolate into the ground, it did not do so, but came up to the surface in a strong stream. Many of the other borings showed similar results.

In view of these conditions, and the fact that a dumping-place was needed for the vast amount of soil to be removed from the site of the reservoir in order to improve the quality of the water, it was decided to make this dike of very great width, as indicated by the sections, and thereby insure safety and a minimum amount of percolation from the reservoir.

The top of the dike is raised 15 ft. above the high-water level in the reservoir, and is made 50 ft. wide. The slopes are four horizontal to one vertical on either side, so that the distance through the embankment at the water level is 170 ft. From this point the down-stream side of the embankment is to have a slope of only 3 ft. in 100. The reservoir slope of the embankment is to be formed of a thick bed of gravel, covered with broken stone and paving or riprap. Where the dike crosses the outlet of Sandy Pond it attains a maximum height of about 68 ft. up to the level of the water in the reservoir, and at this place it has a width, measured along the line of the outlet, of more than two-fifths of a mile.

The dike is divided into two portions by a rocky hill, which rises above the level of the plain. The length of the easterly portion, measured at the level of high water, is 3,815 ft., and of the westerly portion, 4,735 ft., making the total length 8,550 ft. The estimated cost of the easterly portion is $321,370, and of the westerly portion $130,570, making the total estimated cost $451,940.

About two-thirds of a mile south of the main dam there is another low place, where a dike is required to prevent the water of the reservoir from overflowing. The conditions at this place are different from those at the location of the north dike, as the ground is generally higher, and rock is found close to the surface of the ground most of the way, and only about 24 ft. below the surface in the deepest place. This dike is therefore designed as shown on Plan No. 8 (Fig. 2, herewith), to consist of an earth embankment, with a concrete core wall extending to the solid rock. The top of the dike is 50 ft. wide and 10 ft. above the level of the water in the reservoir. The slopes are two horizontal to one vertical, and the one toward the reservoir is to be protected with heavy paving resting upon broken stone. The length of this dike at the level of the water line is 2,500 ft., and its estimated cost is $206,110.

From the reservoir the water will be conveyed 8.87 miles in an aqueduct, shown on the plan, Fig. 1, and in section reproduced directly from the report, by Fig. 3, and then for 3.03 miles in open channel. Both the aqueduct and channel will have a grade of 1 in 2,500 and a capacity of 300,000,000 gallons a day. For the first 1.94 miles from the dam the aqueduct will be in tunnel, as shown by the profile on Fig. 1. The aqueduct will cross the Assabet River on a bridge of masonry arches. The open channel will have a depth of about 10 ft., a bottom width of 20 ft. and slopes of 4 to 1. Dams will be built across it at two points, having adjustable openings to regulate the velocity, so as to prevent scouring and also to maintain a winter capacity beneath the ice. The estimated cost of the aqueduct and channel, including land damages, is $2,265,000.

The open channel terminates in Reservoir No. 5, of the Boston Water-Works. A plan for draining certain swamps in the Sudbury River watershed, in order to improve the quality, especially the color, of the water is given in an appendix prepared by Mr. Desmond Fitz Gerald, M. Am. Soc. C. E. The carrying out of this scheme would be a novel departure in water-works practice, but Mr. Fitz Gerald's studies have been so carefully made that there seems to be no doubt of its success.

At the present high-service pumping station of the Boston Water-Works, at the Chestnut Hill reservoir, it is proposed to place another 20,000,000-gallon pump in the present station, and to provide another station with three high-duty, low-service pumps, each capable of lifting 40,000,000 gallons a day to a height of 40 ft., with great economy, and to a further height of 20 ft., if necessary; also two 2,000,000-gallon extra high-service pumps.

A northern high-service pumping station, with three 15,000,000-gallon high-duty pumping engines, working against 140 ft. head, would be built in Malden, where salt water could be obtained for condensing purposes. A small, extra high-service pumping station would be provided in Arlington, for the further supply of the northern district.

Two small reservoirs, some improvements to existing reservoirs and a distributing system would complete the system, as planned for immediate construction. Cast iron pipe from 48 to 12 ins. in diameter and of a total length of about 95 miles, is proposed for use in the distribution system.

A future aqueduct from Reservoir No.5 of the Boston Water-Works is proposed, with a daily capacity of 250,000,000 gallons and connecting with the Chestnut Hill reservoir and Arlington by means of pipes. This work will not be required for ten years or more. The estimated cost of this aqueduct is $3,226,000, and that of the works, described above and needed at once, is $19,045,800. The several items of the estimate are given in the report, as follows:

Reservoir on Nashua River, including the cost of land, buildings and water rights taken; the relocation of roads and railroads, the removal of all of the soil from the site of the reservoir, the construction of dams and dikes, and all incidental expenses	$9,105,000
Improvement of the watersheds of the Nashua River and of the Stony Brook branch of the Sudbury River by the diversion and purification of sewage and drainage of swamps	513,000
Aqueduct from the Nashua River to the Sudbury watershed, and open channel from the end of the aqueduct to Reservoir No. 5	2,265,000
Additional 48-in. pipe from Dam No. 3 to Dam No. 1 and across the Rosemary Valley	78,800
Pumping stations, reservoirs and pipe systems for elevating and distributing water to all of the cities and towns in the metropolitan district, including the improvement of Spot Pond	5,584,000
Damages for the diversion of water from the Nashua River, and incidental damages not included above	1,500,000
Total first cost of proposed works for supplying water to all of the cities and towns in the metropolitan district	$19,045,800

In discussing the length of time necessary for building the works, Mr. Stearns states that the present level of the Nashua River is such that the aqueduct to the Sudbury watershed could be used as soon as completed, which might be in three years, without waiting for the reservoir, which would take longer.

Many interesting points in the report have not been touched upon in this abstract, and, in fact, could scarcely be brought out without reprinting the greater part of the report, which is about 110 pages in length, besides many maps and other illustrations, not referred to above. The appendices also contain much valuable matter. The first one, apparently by Mr. Stearns, is a brief study of the "Growth of Population in the Boston Metropolitan District," and is of interest to all who have to estimate the increase of populations elsewhere. Appendix No. 2, by Mr. Brackett, already mentioned, is entitled "Present and Future Consumption of Water in the Metropolitan District," and is full of facts and figures, many of which have never been brought together before. Mr. Fitz Gerald's contribution, Appendix No. 3, on "Improvement of the Quality of the Sudbury River Water, by the Drainage of the Swamps Upon the Watershed," is based on four years' careful study of the subject of the colors of the waters forming the Boston supply, and, so far as we know, is not paralleled in engineering research. Professor Drown's study, Appendix No. 5, entitled, "On the Amount and Character of Organic Matter in Soils, and Its Bearing on the Storage of Water in Reservoirs," was abstracted in our issue of Nov. 15, 1894. Series of chemical analyses of the waters from the various sources mentioned, forming Appendix No. 5, were made under the direction of Professor Drown, some of them being reprinted from previous reports of the Board, as was Appendix No. 4, from the report for 1893. The final appendix, No. 6, is by Mr. Brackett, and is on "Water Supply of Different Qualities for Different Purposes." It presents a scheme for utilizing, for industrial purposes only, the present Mystic supply of the Boston Water-Works, which is objectionable in quality, but only in places where there would be no danger of its use for drinking. This danger is one attached to all duplicate water supply schemes, where it is proposed to introduce a minor supply of pure water for domestic purposes and utilize for all other purposes water which is near at hand in large quantities, but which may contain disease germs.

A large amount of study was put into a scheme for filtering the Merrimac River supply, this work having been done by Mr. Allen Hazen, of Boston, as was mentioned above. As this source of supply was rejected by the Board, Mr. Hozen's study is only summarized in the report.

A new breakwater is to be built at Marquette, Mich. The crest will be about 10 ft. above the water level, with a vertical face on the harbor side. On the lake side the face will have two inclined planes separated by a level berme 8 ft. wide, while the width of the flat crest will be 6 ft. Under the crest will be formed a gallery leading to the lighthouse. The work will cost about $100,000.

* Illustrated in Engineering News, June 2, 1892.

YIELD OF SUDBURY RIVER WATERSHED, BOSTON WATER-WORKS, 1875-94.

With the rapidly-growing demands upon available sources of public water supply, figures relating to the run-off of streams are becoming more and more valuable. In considering a given drainage area, the ideal conditions would be detailed records for a long series of years of the rainfall throughout the tributary area, and more especially the actual amount of water which reached the stream or streams in question. Unfortunately, records of run-off are quite rare in this country, so rare that those which exist often have to do service for wide areas of country. Thus, figures for the Croton watershed of the New York supply and for the Sudbury River watershed of the Boston supply are in great requisition by engineers in the immediate vicinity of these areas, and to a less extent throughout the whole of the eastern United States and Canada.

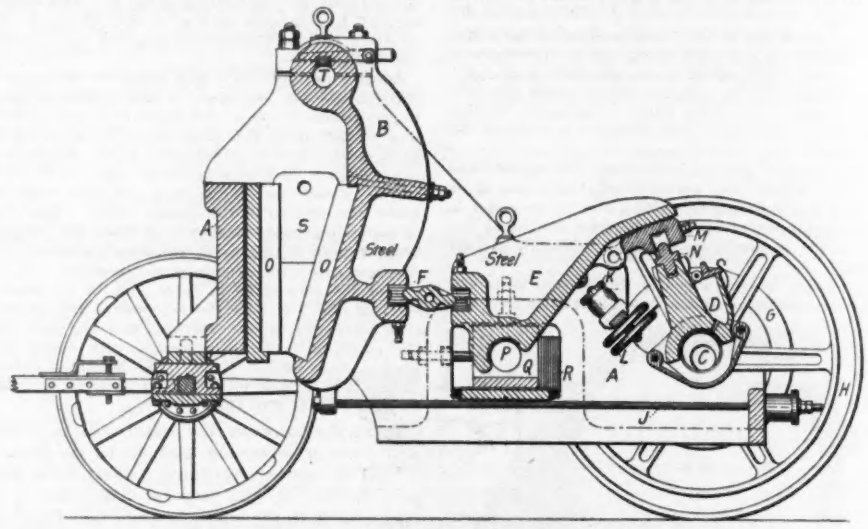
The Boston figures have been more exhaustively studied than any others in this country. In our issue for Oct. 20, 1892, we abstracted a paper by Mr. Desmond Fitz Gerald, M. Am. Soc. C. E., Resident Engineer of Additional Water Supply and Superintendent of the Western Division of the Boston Water-Works, entitled "Rainfall, Flow of Streams and Storage."* This paper gave Boston rainfall records for 74 years and detailed figures of the yield of the Sudbury River for the 16 years ending with 1890. Through the courtesy of Mr. Fitz Gerald, we are enabled to present herewith the monthly yield of the Sudbury River for the past 20 years, or from 1875 to 1894, inclusive. This table brings the record down four years later than in Mr. Fitz Gerald's paper, and has the further advantage of presenting, in figures, what was shown by diagrams in our abstract.

The yield for 1894 was considerably below the average for the 20 years, having been only 770,000 gallons per square mile per day, against 1,058,000 gallons for the period. In fact, only two years out of the 20 (1880 and 1883) were below 1894, although 1892 showed nearly as small an amount as last year.

Express locomotives with a single pair of driving wheels are practically unknown in this country, but an experiment in this direction is being tried on the Philadelphia & Reading R. R. One of the double-end express engines, with four driving wheels and two-wheel leading and trailing trucks (Eng. News, June 15, 1893), has had the parallel rods taken off, and is said to haul easily trains of seven or eight cars, and to ride more steadily than before the rods were taken off. The rear pair of driving wheels are the main drivers. The engine has been running for two or three months.

THE BUCHANAN PORTABLE CRUSHER.

The growing tendency to use concrete in construction works and the growth of the "good roads" movement have been factors in causing an increased demand for portable rock crushers, and this increase in the demand, together with the consequent competition of manufacturers, has led to the introduction of many improvements in this class of machinery. The accompanying cut represents a portable crusher adapted for heavy work, and specially designed for contractors' use and for preparing broken stone for roads. In the design of this machine it has been borne in mind that while lightness of weight is desirable in a machine that has to be transported from place to place, yet strength of parts is even more important, in order to ensure durability and freedom from annoying breakages under the severe conditions of service. In fact, a portable crusher should be made even stronger than a stationary crusher, for the former is frequently mounted on a temporary foundation, which is more or less unstable, thus allowing racking strains to be set up, while the machine usually receives less care and attention and is subjected to more rough usage than one which forms part of a permanent plant. In some portable machines these points have been overlooked, and the main feature has been the reduction of weight.



THE BUCHANAN PORTABLE ROCK CRUSHER.

In the Buchanan portable crusher, shown herewith, the main frame A is cast in one piece, and the journals and bearings for all the moving parts are cast solid with it, so that there are no bolts or joints to work loose, as in built-up or sectional frames, and at the same time there is less liability of the parts getting out of line and causing heating or breakages. For this casting a mixture is used, which produces a strong tough iron, having a tensile strength of 25,000 to 30,000 lbs. per sq. in. For the swinging jaw B, open-hearth steel is used, so as to combine great strength with comparatively light weight, and this jaw is operated from the eccentric shaft C by means of the pitman D, the lever E and the toggle F. The arm E is of steel, and the eccentric shaft runs in long babbitted journals in the main frame. This shaft carries the pulley G and flywheels H. The swinging jaw is held firmly against the toggle by the rod J, the end of which passes through the back of the frame and is fitted with a rubber spring, which is compressed during the forward stroke and assists the return stroke, while it exerts sufficient pressure to prevent lost motion between the parts. In order to allow of adjusting the jaw to crush to small sizes, the stop K is provided, which is carried by a rubber spring seated on a cross-bar of the frame. A threaded bolt through the spring and cross-bar is adjusted by the handwheels L, the lower one of which acts as a jam nut, to prevent the wheels from working loose and slackening the bolt. When running at full stroke the steel lever E will clear the spring, but if the nature of the material or the desired fineness of output makes it necessary to shorten the stroke of the jaw, the handwheels L are slackened to allow the spring to expand, when the stop K arrests the stroke of the lever, the spring then acting as a cushion. By this means the stroke can be readily adjusted to meet the requirements for varying sizes of output. As the throw of the eccentric shaft and the stroke of pitman D are constant, a swinging shoe, M, is attached to the back end of lever E by lugs and a pin, in order to keep the toggle and bearing N in contact during the entire revolution of the shaft, when the stroke of the jaw is shortened, as above described.

The lever arrangement of transmitting motion from the shaft to the jaw has been adopted in order to relieve the strain on the frame. When the ordinary direct toggle transmission is used, the rear of the machine receives the thrust of the toggles, and, therefore, sustains the same strain as the crusher head and jaw, the entire frame being then in tension. In the Buchanan crusher the only tensile strain on the frame is between the lever pin, P, and the jaw pin, T, and attention is called

*For the full paper see Trans. Am. Soc. C. E., vol. XXVIII. (July-Dec., 1892), p. 253.

YIELD OF THE SUDBURY RIVER WATERSHED OF THE BOSTON WATER-WORKS FOR THE YEARS 1875 TO 1894, INCLUSIVE. DESMOND FITZ GERALD, M. AM. SOC. C. E., RESIDENT ENGINEER AND SUPERINTENDENT.

(Area of Watershed, 75.2 sq. miles.)

Millions of U. S. Gallons per Square Mile per Day.

	1875.	1876.	1877.	1878.	1879	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	'75-'94.
January	0.103	0.643	0.658	1.810	0.700	1.120	0.415	1.241	0.335	0.995	1.235	1.461	2.589	1.053	2.782	1.254	3.018	1.870	0.434	0.693	1.220
February	1.496	1.368	0.949	2.465	1.711	1.787	1.546	2.403	1.033	2.842	1.354	4.801	2.829	1.950	1.196	1.529	3.486	0.943	1.542	0.991	1.910
March	1.604	4.455	4.814	3.507	2.339	1.374	4.004	2.839	1.611	3.785	1.572	2.059	2.868	3.228	1.338	3.643	4.453	1.955	3.245	2.238	2.846
April	3.949	3.292	2.394	1.626	3.116	1.169	1.546	0.867	1.350	2.853	1.815	1.947	2.620	2.645	1.410	1.875	2.397	0.871	2.125	1.640	2.030
May	1.188	1.138	1.391	1.394	1.114	0.514	0.965	1.292	0.937	1.030	1.336	0.720	1.009	1.632	0.880	1.366	0.583	1.259	2.883	0.840	1.174
June	0.870	0.222	0.597	0.506	0.413	0.175	1.338	0.529	0.300	0.416	0.426	0.203	0.413	0.421	0.653	0.568	0.413	0.428	0.440	0.419	0.488
July	0.321	0.183	0.202	0.128	0.157	0.176	0.276	0.086	0.115	0.224	0.062	0.116	0.115	0.117	0.634	0.107	0.149	0.214	0.158	0.161	0.185
August	0.396	0.405	0.121	0.476	0.395	0.119	0.148	0.055	0.079	0.257	0.240	0.094	0.214	0.379	1.432	0.132	0.163	0.280	0.181	0.209	0.289
September	0.207	0.184	0.060	0.101	0.141	0.080	0.197	0.307	0.091	0.044	0.121	0.117	0.111	1.155	0.823	0.457	0.263	0.229	0.108	0.150	0.247
October	0.646	0.234	0.631	0.516	0.071	0.102	0.186	0.299	0.186	0.083	0.336	0.146	0.190	1.999	1.230	2.272	0.210	0.126	0.222	0.374	0.503
November	1.302	1.088	1.418	1.693	0.206	0.205	0.395	0.209	0.205	0.175	1.177	0.673	0.369	2.758	1.941	1.215	0.305	0.697	0.319	0.836	0.850
December	0.584	0.453	1.290	3.177	0.463	0.175	0.775	0.315	0.194	0.925	1.174	1.020	0.643	3.043	2.241	0.996	0.554	0.485	0.796	0.716	1.000
Mean	0.972	1.135	1.214	1.452	0.894	0.578	0.979	0.862	0.533	1.129	0.901	1.087	1.154	1.697	1.383	1.285	1.315	0.781	1.037	0.770	1.058

Cubic Feet per Second per Square Mile.

January	0.159	0.995	1.019	2.800	1.083	1.733	0.642	1.920	0.518	1.540	1.910	2.260	4.006	1.629	4.305	1.941	4.669	2.893	0.671	1.072	1.888
February	2.315	2.116	1.469	3.814	2.647	2.765	2.392	3.718	1.598	4.397	2.095	7.428	4.377	3.011	1.850	2.366	5.393	1.459	2.386	1.533	2.955
March	2.482	6.862	7.448	5.426	3.605	2.126	6.195	4.392	2.492	5.857	2.433	3.185	4.437	5.009	2.071	5.636	6.891	3.025	5.021	3.463	4.403
April	4.718	5.094	3.703	2.516	4.821	1.808	2.392	1.342	2.088	4.415	2.808	3.013	4.053	4.093	2.182	2.900	3.709	1.348	3.288	2.538	3.141
May	1.838	1.761	2.153	2.158	1.723	0.796	1.493	1.998	1.450	1.594	2.067	1.114	1.561	2.526	1.361	2.114	0.901	1.947	4.461	1.299	1.816
June	1.346	0.343	0.924	0.782	0.640	0.271	2.070	0.818	0.464	0.644	0.659	0.314	0.640	0.652	1.011	0.878	0.639	0.662	0.680	0.648	0.754
July	0.497	0.283	0.312	0.199	0.243	0.273	0.428	0.133	0.178	0.346	0.096	0.179	0.178	0.182	0.980	0.166	0.231	0.331	0.244	0.249	0.286
August	0.612	0.627	0.187	0.736	0.611	0.184	0.229	0.086	0.122	0.397	0.372	0.146	0.331	0.587	2.216	0.204	0.252	0.433	0.280	0.324	0.447
September	0.321	0.285	0.092	0.249	0.218	0.124	0.305	0.474	0.141	0.068	0.187	0.182	0.172	1.786	1.274	0.708	0.314	0.355	0.167	0.231	0.383
October	1.000	0.361	0.977	0.799	0.109	0.157	0.287	0.463	0.288	0.129	0.519	0.225	0.294	3.093	1.903	3.515	0.325	0.195	0.343	0.579	0.778
November	2.015	1.683	2.193	2.619	0.318	0.318	0.611	0.324	0.317	0.271	1.822	1.041	0.570	4.267	3.003	1.879	0.472	1.079	0.493	1.293	1.329
December	0.903	0.702	1.995	4.916	0.716	0.271	1.199	0.487	0.299	1.431	1.816	1.578	0.995	4.708	3.467	1.541	0.842	0.750	1.232	1.108	1.548
1875-1894	1.504	1.756	1.878	2.246	1.383	0.895	1.515	1.334	0.824	1.747	1.393	1.682	1.785	2.626	2.140	1.989	2.034	1.209	1.604	1.192	1.637

to the great strength of the frame at this part, and to the short distance between the lever pin and the crusher head. That part of the frame back of the pin is subjected only to the thrust of the pitman, and the arrangement of the leverage is such that the strain on the journals and pitman is only about one-tenth of that on the crusher head, and the frame and pitman can, therefore, be reduced considerably in size and weight without weakening the machine. By thus disposing the strains in the frame and by substituting steel for iron in the jaw and lever, it is claimed that the machine can be made stronger than other machines for a given weight.

The distance between the chilled jaw plates or crushing plates, O O, is regulated by means of an adjustable bearing for the pin, P, upon which the lever, E, turns. The bearing is cast in one piece, the boxes, Q, being connected by a cross-piece, which is placed on the bottom and rests upon a planed plate let into the frame of the machine and secured by a zinc joint. The bearing is held firmly against the packing plates, R, by means of the horizontal set screws shown, and by removing some of these plates or putting in extra ones, any required adjustment can be made. No strain, due to the crushing stroke, is imposed upon the set screws, the line of strain on the bearing being downward and backward. The jaw plates, O O, are planed on the back, and when worn at the bottom can be inverted. The cheek plates, S, can also be changed to the opposite sides, so as to present new surfaces for wear. The steel end bearings of the toggle, F, are placed on two sides and provided with double seats, so that they can be interchanged when worn. The lever bearings and toggle at N are also made with double seats and double ends for reversing, the pockets in the jaw and levers being planed out to ensure a perfect fit with the toggle bearings. The pin, T, from which the swinging jaw is hung has a steel bearing to take up the wear, the bearing being adjusted by a taper key and set screw in the jaw.

On the front of the crusher head, at its lower edge, are cast two strong brackets, to which is bolted a cross-piece, having a hole in the middle to receive the king-bolt of a special truck, as shown in the cut, or of the forepart of an ordinary lumber wagon. The special truck can be furnished with the crusher. When the crusher is to be made ready for transportation, the head is jacked up a few inches, the ordinary timber foundation removed and the truck run into place, so that the king-bolt will engage with the hole in the cross-piece above mentioned. The jack is then slackened or the underpinning removed, and the machine then rests on the truck wheels in front and the flywheels in the rear, the latter acting as carrying wheels. If it is desired to lighten the machine for transport, the jaw, lever and pitman can be removed. The jaw and jaw pin can be removed by unbolting the cap of the top bearing, and the lever can be lifted off, having a slotted bearing open on the bottom. Both jaw and lever are fitted with eye-bolts for attaching hoisting tackle. The pitman has no cap, as the strains are all in compression, but there is a light hinged drip-pan, to receive cotton waste and surplus oil; this can be quickly unhinged to allow of the removal of the pitman. Among the advantages claimed for this machine are the following, in addition to those of strength and lightness already referred to:

1. The jaw opening is very low and is easy to feed.

2. There is ample room under the jaw for the introduction of a chute, elevator or screen.

3. The working parts are in plain sight, easy to oil, adjust or replace.

4. It can be quickly changed to give an output of coarse or fine material, and the stroke can be adjusted to suit any material or product required.

5. It is readily portable, and does not require any high lifts or expensive trucks to fit it for transportation.

This style of crusher is made in three sizes, with openings 7×12 ins., 8×14 ins. and 10×16 ins. When large capacity is required for stationary plants, two or more jaws are arranged in the same frame, each jaw having its own lever, toggles and pitman, and the eccentric shaft having intermediate bearings to support the extra length, while the eccentrics are so placed that the jaws work with alternating strokes, thereby reducing the strain on the frames and journals. Machines of this class are built with a capacity of 100 tons per hour.

The crusher is built by the Beckett Foundry & Machine Works, of Arlington, N. J., and was designed by Mr. C. G. Buchanan, Mechanical Engineer, who is Consulting Engineer for the makers, and has his office at their New York headquarters, 143 Liberty St., New York city.

SPECIFICATIONS FOR A SUSPENSION BRIDGE OVER THE HUDSON RIVER, AT NEW YORK.

The project of the New York & New Jersey Bridge Co. for a railway bridge over the Hudson River, at New York city has been frequently discussed in our columns, and it will be remembered that the Secretary of War refused to approve the company's plans for a cantilever bridge. The company, therefore, had new plans prepared for a stiffened suspension bridge, and we are indebted to Mr. Theodore Cooper, M. Am. Soc. C. E., Consulting Engineer to the company, for a copy of his general specifications for the structure, which we reprint in full, as follows:

The great importance and cost of this proposed bridge and the difficulty of foretelling the future demands on its traffic capacity require that it should be capable of carrying any traffic brought to it by the connecting lines, without any restrictions as to speeds, loads, frequency of trains, or other limitations differing from those in force upon well-regulated railways. The specifications, therefore, define the capacity, strength and legal restrictions under which the bridge is to be built. But upon all points where the bidder is at liberty to seek the best and most economical design, the specifications are intentionally made very general. Before the acceptance of any proposal, detail specifications defining the methods proposed by the bidder, and which must be at least equal to the best practice of the day, will be prepared to supplement these general specifications.

The bridge will be located at such points, between 59th and 69th Sts., New York city, as may be approved by the Secretary of War. The bridge will have a clear span of 3,100 ft., the piers being located inside the pier-head lines. The elevation shall be such that the bridge shall afford, under any conditions of load or temperature, a clear headway above high water of spring tides of not less than 150 ft. at the center of the span. The bridge will have six standard railway tracks upon one level.

The general type of the proposed bridge will be a steel wire suspension bridge, stiffened for moving load by longitudinal girders extending from tower to tower. The main span only, or that portion between the towers, will be carried by the cables. The side spans, or that portion between the towers and anchorages will be carried upon viaducts, independent of the cables. The towers will be steel skeleton structures, commencing at an elevation about 50 ft. above high water, where the masonry piers end. All the connections must be riveted, and all the bracing must be rigid.

The stiffening trusses will be riveted lattice girders, with multiple systems of diagonal web bracing. They may be made continuous from tower to tower, or they may be made with a central hinge, at the option of the bidder. All the lateral and sway bracing of the main span and the towers will be formed of rigid members, capable of resisting either tension or compression. The transverse and longitudinal floor beams will be riveted plate girders; there must be two longitudinal girders, under each track. The anchorage bars will be eye-bars of medium steel, and the anchorage pedestals will be built from forms of medium steel, and will rest on dressed granite blocks carefully bonded into the adjoining masonry.

Each bidder can select such depth of versine, number and arrangement of cables, depth of stiffening trusses, and general details as he may deem best, within the requirements of these specifications. The main piers and the anchorages will be founded upon the rock. The viaduct piers may be founded upon the rock, or upon piles, or such other form of foundation as may be approved by the Chief Engineer. Bidders must submit with their proposals plans for the anchorages and piers, showing the proposed methods of founding, their general construction, and the character of the masonry. The exposed faces of all masonry will be of granite or other approved stone.

Loads.

The structure shall be proportioned to carry the following loads, the first two of which, taken together, shall constitute the "dead" or "permanent" load, while items 3, 4 and 5 will be known as the "live" loads:

1. The weight of rails, ties, guards, footwalks, etc., above the longitudinal track girders, shall be taken as 400 lbs. per lin. ft. of each track.

2. The weight of metal in the structure.

3. Trains weighing 3,000 lbs. per lin. ft. of track, covering all the tracks from tower to tower, at rest or moving slowly.

4. Trains 1,000 ft. in length, and weighing 3,000 lbs. per lin. ft., upon each of the six tracks; these trains being supposed to be moving at high speeds, either all in one direction or the three on the north tracks in one direction and the three on the south tracks in the opposite direction.

5. For the floor girders and other members, which will get their greatest stress from engine loads, a uniform load of 3,000 lbs., increased by a concentrated load of 50,000 lbs., upon each track.

6. Wind: The structure covered with trains of cars will be assumed to be acted upon by a wind force of 25 lbs. per sq. ft. of surface; or a wind force of 100 lbs. per sq. ft. of surface of the bridge only, for a length of 300 ft. The wind will be supposed to act either horizontally or at an angle of 30° above or below the horizontal; but the horizontal component only need be considered.

7. Temperature: A range of temperature of 75° F., above and below the mean, shall be considered in proportioning all parts of the structure.

The modulus of elasticity of the cables will be assumed as 30,000,000 lbs., and for the trusses and other parts made from structural steel as 28,000,000 lbs. The coefficient of expansion for steel will be assumed as 0.0005 for 75° F. All parts of the structure shall be proportioned to meet the maximum conditions produced by combination of the "dead" load with either of the "live" loads 3, 4 or 5, the wind and temperature.

Allowed Unit Strains.

Members Subject to Tension.—Cables: Under the above-specified loads, the allowed tension upon the wires in the cables shall not exceed a maximum of 54,000 lbs. per sq. in.

Suspenders: The allowed tension in the suspenders shall not exceed 30,000 lbs. per sq. in. of the section of the wires.

Cross-stays: The wire ropes used for staying the cables together may be strained to 60,000 lbs. per sq. in. of the wires.

Anchor Bars: The anchor bars may be strained to 20,000 lbs. per sq. in.

Floor Hangers, etc.: Forged steel hangers and similar members shall not be strained more than 7,500 lbs. for "live" loads, and 15,000 lbs. for "dead" loads.

Floor Girders: These girders shall be proportioned upon the supposition that the bending or chord strains are resisted entirely by the upper and lower flanges, and that the shearing or web strains are resisted entirely by the web plates. No part of the web plate shall be estimated as flange area. Under these conditions the lower flanges of the longitudinal floor girders shall not be strained above 10,000 lbs. per sq. in. of net section. The lower flanges of the transverse floor girders, when subject to tension only, shall not be strained above 15,000 lbs. per sq. in. of net section. The top flanges of such girders will be made of the same gross sections as the lower flanges; but the flanges must be stayed against transverse crippling at distances not exceeding 20 times their width.

Stiffening Trusses: The chords of the stiffening trusses, when subject to tension only, shall not be strained above 18,000 lbs. per in. of net section by the live loads, nor more than 22,500 lbs. by the combined action of live loads, temperature and wind. Tension members of the lateral and sway systems shall not be strained in tension above 18,000 lbs. per sq. in. of net section.

Members Subject to Compression.—The columns of the towers shall be so proportioned that the maximum compression per square inch will never exceed that given by the following formula:

$$P = 20{,}000 - 70\frac{l}{r}$$

For the compression struts in the lateral or sway system of bracing, the unit strain must not exceed:

$$P = 17{,}500 - 75\frac{l}{r}$$

Where P = allowed unit strain; l = length in inches, and r = least radius of gyration in inches.

The chords of the stiffening trusses, when subject to compression only, shall not be strained by live loads above

$$P = 17{,}500 - 60\frac{l}{r}$$

nor by the combined action of live loads, temperature and wind above

$$P = 22{,}500 - 80\frac{l}{r}$$

Members Subject to Reversal of Strains by Live Loads.—Under the reversal of strains by live loads,

the chords of the stiffening trusses shall not be strained above the unit strains given by the following formulas:

$$t = \frac{T}{T + aC}\ 20{,}000$$

$$c = \frac{aC}{T + aC}\ (20{,}000 - 70\frac{l}{r})$$

And the web diagonals of the stiffening trusses by the following:

$$t = \frac{T}{T + aC}\ 18{,}000$$

$$c = \frac{aC}{T + aC}\ (17{,}500 - 75\frac{l}{r})$$

Where t = the allowed tension per square inch; c = the allowed compression per square inch; T = total tension on the member; C = the total compression on the member; a = value of the net section in terms of the gross section; and l and r as before.

Should the transverse floor beams be subject to reversal of strains by the live loads, the allowed strains will be reduced in a similar manner.

Shearing Strains and Bearing Pressures.—The shearing strain and bearing pressures upon the rivets or pins connecting any members shall never exceed 75% and 150%, respectively, of the maximum allowed tension or compression on these members for any particular loading.

Pins shall not be subjected to a greater bending strain than 18,000 lbs. per sq. in., under the assumption that the middle halves of the bearing surfaces of the several members are considered as uniformly loaded with the applied forces. The webs of plate girders must be stiffened, at intervals not exceeding the depth of the girders, wherever the shearing strain is greater than that given by the following formula:

$$s = \frac{12{,}000}{1 + \frac{H^2}{3{,}000}}$$

where H = ratio of depth of web to its thickness.

Masonry.—The pressures transmitted to the masonry by the towers or anchor pedestals shall not exceed 40,000 lbs. per sq. ft. of surface under the maximum possible loading. The pressure within the masonry or upon the rock foundation shall not exceed 20,000 lbs. per sq. ft. after allowing for displacement of the water, silt and sand; the weight of water being taken at 63 lbs., silt at 100 lbs., and sand at 120 lbs. per cu. ft.

The pull of the cables must be resisted by that part of the anchorage masonry which is above mean high water, and its value for this purpose will be determined by the following factors: Weight per cubic foot of masonry to be taken as 150 lbs.; coefficient of friction as 0.6; factor of stability as 2.

Details of Construction.

The arrangement of the anchorages must be such that all parts of the cables, anchorage links and pedestals, other than the pedestal bearings, shall be readily accessible for inspection, cleaning and preservation. The towers and cables must be treated on the supposition that the saddles are, or may become, immovable. The effects of the wind upon the cables may be provided for by cradling the cables and staying them together. The effects of the wind upon the floor and trusses must be provided for by a suitable system of lateral and sway bracing between the chords of the stiffening trusses.

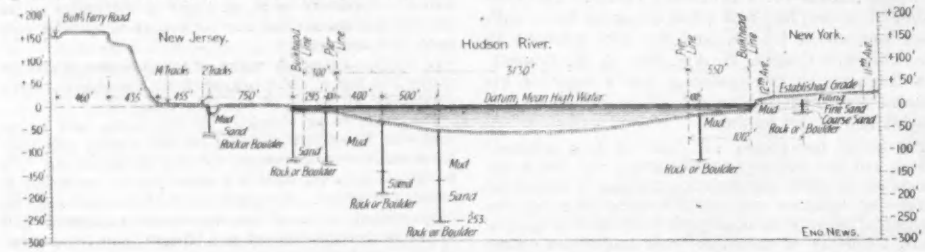
The suspenders may be made of wire ropes, or cables of straight wires, suitably wrapped. The cables must be so arranged that those on each side will be equally strained under any loading. The stiffening trusses shall be given a camber of 5 ft. when at their lowest position from load and temperature.

No compression member with a length greater than 125 times its least radius of gyration will be allowed. No plate or shaped forms of steel of a less thickness than ⅝ in. shall be used. All details and connections shall be of such proportions that upon testing to rupture they may be of equal strength to the members they connect.

All parts must be accessible to cleaning, painting and inspection. No closed forms will be allowed. Wherever possible, all rivets must be driven by power riveters. All bearing surfaces and abutting joints must be accurately tooled. All details of the structural work and all methods of manufacture must be equal in character to the best practice in American bridge work.

All the wires in the cables must be carefully and accurately adjusted for the positions they will finally occupy in the finished cables. The wires in each strand must be continuously spliced. The length of the wires shall be so arranged that the splices will be uniformly distributed throughout the strands and cables. The splices must be satisfactory to the engineer, but a splice which will give 75% of the strength of the wire without any enlargement at the splice will be considered preferable to one which creates an enlargement, with a greater percentage of strength.

The wires of each cable must be thoroughly compacted into a cylindrical form, saturated with a selected preserving preparation, and then closely and firmly bound together by a wire wrapping put on in the most approved manner. Parts inaccessible to the wrapping process must be protected to the satisfaction of the engineer. The unprecedentedly large diameter



CROSS SECTION OF HUDSON RIVER AT PROPOSED SITE OF NEW YORK & NEW JERSEY BRIDGE AT 60TH ST., NEW YORK CITY.

of the cables for a bridge of the size of this structure will demand that the strands be squeezed together and wrapped in two or more processes, the inner strands being treated as a separate cable, around which the additional strands will be placed, squeezed and wrapped. The number of these processes shall be determined by the engineer after the size and manner of making the cable have been selected.

The pull of the suspenders in the direction of the cables must be taken up otherwise than by the friction of the cable bands produced by bolts through their flanges. Only 20% of the normal pressure upon the cables, produced by the load on the suspenders, shall be considered as resisting this pull. The remainder must be taken up by supplementary cables or ropes, running from the saddles to the suspender connections, or some equally acceptable device.

Materials of Construction.

Masonry.—The kind and quality of all stone, cement, sand and other materials used in the foundations or the masonry must be to the satisfaction and approval of the engineer. The masonry of each part of the work shall be thoroughly compacted and cemented into one solid mass free from voids, and each class of masonry shall be in all particulars fully equal to the best accepted practice of the day for its class.

For the main piers, where great strength is desired, the selected kind of masonry must be made of such materials and be so bonded that the required strength will be obtained. For the anchorages, where weight of masonry is the more important element, a chief class of masonry may be used for the interior, but externally, this masonry must be of granite or other selected stone of such forms, dimensions and projections as will give a suitable appearance for a work of this magnitude at this location.

Each bidder must clearly specify the kind and quality of masonry proposed for each part of the work.

Built Structural Work.—The stiffening trusses, floor, bracing, towers, anchor bars, pins, hangers and pedestals will be of "medium steel," which will have an ultimate strength of 60,000 to 80,000 lbs. per sq. in., an elastic limit of not less than 33,000 lbs., and a minimum elongation of 20% in 8 ins., when tested by samples cut from the finished bars, having a length of 12 ins. and a uniform sectional area of ½ sq. in.

Before or after heating to a low cherry red and cooling in water at 82° F., this steel must stand bending to a curve whose inner radius is one and a half times the thickness of the sample, without cracking. The finished bars, plates and shapes must be free from cracks on the faces and corners, and have a clean, smooth finish. All sheared edges of plates and other forms must be planed off to a depth of ¼ in. All rivet holes must be drilled after the several pieces forming one member are assembled together, or they may be punched, and, after assembling, reamed to a diameter ⅛ in. larger.

All forged work must be finally annealed. All rivets shall be of soft steel. The saddles may be steel castings.

Wire.—The wire for the cables shall not be less in diameter than No. 3, Birmingham gage, or 0.259 in. It shall be bright, "straight" wire, free from any tendency to coil when unrolled. Machine-straightened wire will not be accepted. It must be perfectly free from nipper marks. It must have an ultimate strength of 180,000 lbs. per sq. in., an elastic limit of 90,000 lbs. per sq. in., and an elongation of 4% in a length of 1 ft.; it must stand wrapping around a rod ½-in. diameter at least four turns without evidences of fracture. Each wire must have a minimum length of 1,800 ft. without weld, joint or splice.

A variation in diameter not exceeding 0.006 in. will be permitted in the length of one wire, and a variation in the minimum size of the various wires not exceeding 0.002 in. All wire, as soon as made, must be passed through an approved preparation of linseed oil to protect it from oxidation. After testing and acceptance of the coils, they will be jointed and coiled upon suitable drums for transportation, in lengths as great as can be practically handled or transported. The drums must be of such a diameter as not to injure the straightness of the wire. All the wire shall be subject to the following tests:

1. Each ring may be tested for tensile strength, elastic limit, elongation and bending, by samples cut from either end of the wires.

Or, 2. Upon satisfactory evidence that the stock and method of manufacture are uniform, one wire from each 40 may be selected as the basis of acceptance or rejection of the whole 40. In this case the length of wire of 40 ft. may be cut from any part and subjected to test. Such piece must show an ultimate strength of 180,000 lbs. per sq. in., an elongation over its whole length of 2%, and an elastic limit not less than 90,000 lbs. per sq. in. It must also answer the requirements of the wrapping test.

3. More frequent tests than the above may be made by direction of the engineer, but for such additional tests the loss of the material and expense of testing shall fall upon the bridge company in case the wire complies with the specifications; otherwise they shall be at the contractor's cost.

The wrapping wire will be No. 8 B. W. G. for the external wrapping, and No. 10 B. W. G. for the internal wrappings. It must be annealed steel wire, and have an ultimate strength of not less than 80,000 lbs. per sq. in.

If the suspenders are made from straight wires wrapped, the wire must not be less in size than No. 6 B. W. G., and be equal in quality to the wires of the cables. If the suspenders are made from wire ropes, the ropes must be of steel wire, with a wire core. The ropes must have an ultimate strength of 180,000 lbs. per sq. in. of the cross-section of the wires and an elastic limit of at least 90,000 lbs. The wires must not be less than No. 10 B. W. G., and must stand wrapping around a ½-in. rod, and being unwrapped without fracture.

Inspection and Testing.

The contractor of any class of work under these specifications must furnish all proper facilities for the inspection of all materials and workmanship. He must supply and operate the necessary testing machines, and furnish the required specimens without charge. Full-sized members may be tested to destruction at the option of the engineer, but such material shall be paid for at cost if it fulfills the specification requirements; otherwise it will be at the loss of the contractor.

Painting.

All the structural work before leaving the shop shall be thoroughly cleaned from all scale and rust by means of wire brushes, and then be given one good coat of a selected preparation made with pure linseed oil, well worked into all joints and open spaces, so as to render them watertight. In riveted work the surfaces coming in contact shall each be painted before being riveted together. All surfaces which will not be readily accessible after the work is erected must be given two coats. After the work is erected it shall be thoroughly and evenly painted with two additional coats of such composition and color as may be directed.

All the wire work shall be fully saturated with a preparation of linseed oil as the work progresses. After completion all recesses where water could lodge or enter must be thoroughly protected by a suitable waterproofing material. The work shall then be given two coats of paint.

Plans and Strain Sheets.

Proposals must be accompanied with strain sheets, general plans, representative details and such detail specifications as will clearly and definitely show the strength and character of the proposed plan, and the methods to be employed in its construction. "All the plans and specifications, with the necessary drawings of said bridge, shall be submitted to the Secretary of War for his approval, and before such approval the construction shall not be begun."—(Act of Congress, approved June 7, 1894.)

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PERSONALS.

Mr. F. O. Taylor, Assistant Superintendent of Construction of a new bridge near Pittsburg, Pa., was killed recently on the works.

Mr. K. E. Hilgard, M. Am. Soc. C. E., of St. Paul, Minn., has been engaged as Engineer for the reconstruction of a large dock at Duluth, Minn.

Mr. W. A. Williams, General Superintendent of the Texarkana & Fort Smith R. R., has been appointed General Manager, with office at Texarkana, Tex.

Mr. Charles H. Graham, engineer in charge of the new Harlem Speedway for the New York Park Commission, has resigned. He has been in the service of the commission since 1879.

Dr. A. R. C. Selwyn has retired from his position as Director of the Geological Survey of Canada, and has been succeeded by Dr. George M. Dawson, son of Sir Wm. Dawson, the geologist.

Mr. Le Grand Brown has resigned his position as engineer for the new water-works conduit at Rochester, N. Y., to take charge of the construction of the sewerage system of Charlotte, N. Y.

Mr. W. W. Wallace, Assistant Superintendent of the New York Division of the New York, New Haven & Hartford R. R., has resigned, and Mr. P. M. Bowman has been appointed his successor.

Mr. O. Hoff, of Rinker & Hoff, Lumber Exchange Bldg., Minneapolis, Minn., has been engaged as Consulting Engineer by the Chicago Great Western R. R. to remodel and reconstruct its bridges.

Col. H. G. Prout, M. Am. Soc. C. E., Editor of the "Railroad Gazette," delivered a lecture on "Steel Rails" before the students of the Rensselaer Polytechnic Institute, at Troy, N. Y., on March 1.

Mr. S. F. Hay, who died at Metuchen, N. J., on Feb. 24, had been for many years engaged with the Isbell-Porter Co., of New York, in the design and construction of gas and refrigerating machinery.

Mr. L. Russell Clapp, First Assistant Engineer in the Public Works Department of Brooklyn, N. Y., has resigned. Mr. Charles H. Meyer has been appointed First Assistant Engineer in the Bureau of Sewer Construction, and Mr. Bernard M. Wagner and Frederick V. Carpenter have been appointed Assistant Engineers in the bureaus of Water Supply and Local Improvement, respectively.

Capt. William Millar, Division Engineer of the Kansas City, Pittsburg & Gulf R. R., died of pneumonia at Horatio, Ark., Feb. 18. He was born near Erie, Pa., about 1824, began his career on the Erie Canal, and received his early railway training under Mr. W. Milnor Roberts. He located portions of the Lake Shore & Michigan Southern Ry. in 1848, and had since located and constructed portions of the Atchison, Topeka & Santa Fe; Denver & Rio Grande; Kansas City, Fort Scott & Memphis; Kentucky Southern, East Tennessee, Virginia & Georgia, and other railways. He was also prominent in working up plans for an international dam across the Rio Grande near El Paso, and was identified with other irrigation plants and projects in the Pecos River Valley and in San Bernardino county, Cal. During the war he raised a company of railway men and served as captain, his company doing engineering and heavy artillery work. He was a member of the Kansas City Engineers' Club and the Missouri Society of Engineers and Surveyors' Association.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

MONTANA SOCIETY OF CIVIL ENGINEERS.
March 9. Secy., Forrest J. Smith, Denver Block, Helena, Mont.
INDIANAPOLIS ENGINEERING CLUB.
March 9. "Steel Construction in Architecture," by C. E. Hildebrand. Secy., C. C. Brown, City Engineer.
ENGINEERS' CLUB OF KANSAS CITY.
March 11. Secy., F. W. Tuttle, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
March 12. Secy., W. K. Means, Loan & Trust Building, Milwaukee.
NORTHWESTERN SOCIETY OF ENGINEERS.
March 12. Secy., D. W. McMorris, Burke Building, Seattle, Wash.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
March 12. Secy., F. C. Osborn, Case Library Building.
NORTHWESTERN RAILWAY CLUB.
March 12. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
DENVER SOCIETY OF CIVIL ENGINEERS.
March 12. Secy., H. Breen, 36 Jacobson Block.
NEW ENGLAND WATER-WORKS ASSOCIATION.
March 13. Regular quarterly meeting. At Young's Hotel, Boston, Mass. Secy., John C. Whitney, West Newton, Mass.
NEW ENGLAND RAILROAD CLUB.
March 13. Secy., F. M. Curtis, P. O. Box 1576, Boston, Mass.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
March 13. "Rapid Transit in Large Cities," by W. B. Parsons. Secy., F. R. Hutton, 12 W. 31st St., New York.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
March 14. Secy., Jas. K. Zollinger, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
March 14. Secy., H. D. Ruhm, Nashville, Tenn.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
March 15. Secy., D. W. Meeker, St. Paul, Minn.
FRANKLIN INSTITUTE, PHILADELPHIA.
March 15. "Lightning Arresters," by A. J. Wurts. Secy., W. H. Wahl, 16 South Seventh St., Philadelphia.
ENGINEERS' CLUB OF PHILADELPHIA.
March 16. Secy., L. F. Rondinella, 1122 Girard St.
ENGINEERS' CLUB OF MINNEAPOLIS.
March 18. Secy., E. Nexsen, Kasota Block.
WESTERN RAILWAY CLUB.
March 19. Secy., W. D. Crosman, Club Room 9, Grand Pacific Hotel, Chicago.
COLUMBIAN ENGINEERING SOCIETY.
March 19. Secy., W. F. Hart, University Building, 15th and H. Sts. N. W., Washington, D. C.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
March 20. Secy., J. H. Pilcher, Roanoke, Va.
ENGINEERS AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
March 20. Secy., F. Van Vleck, Los Angeles, Cal.
BOSTON SOCIETY OF CIVIL ENGINEERS.
March 20. Secy., S. E. Tinkham, City Hall. Rooms, 36 Bromfield St.
ENGINEERS' CLUB OF ST. LOUIS.
March 20. "European Engineering Schools," by W. S. Chaplin. Secy., W. H. Bryan, Turner Block.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
March 20. "The Topographic Survey of the United States," by H. M. Wilson. Secy., C. W. Hunt, 127 E. 23d St., New York.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
March 21. Secy., C. H. McLeod, 12 Mansfield St., Montreal.
NEW YORK RAILROAD CLUB.
March 21. Secy., John A. Hill, 256 Broadway, N. Y. City.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
March 21. Secy., D. Carhart, Carnegie Library Building, Allegheny.
ENGINEERS' CLUB OF CINCINNATI.
March 21. Secy., J. F. Wilson, Odd Fellows' Temple.
CENTRAL RAILWAY CLUB.
March 27. Secy., H. D. Vought, Buffalo "Courier," Buffalo, N. Y.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
April 1. Secy., C. L. Annan, City Engineer's Office.
ENGINEERING SOCIETY OF WESTERN NEW YORK.
April 1. Secy., Geo. R. Sikes, 122 Pearl St., Buffalo, N. Y.
WESTERN SOCIETY OF ENGINEERS.
April 3. Secy., Chas. J. Roney, 1736 Monadnock Block, Chicago.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
April 5. Secy., O. H. Van Geldern, 319 Market St., San Francisco.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
April 18. Atlanta, Ga., Secy., F. A. Charpiot, Macon, Ga.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.—At the meeting on Feb. 22, Mr. John A. Brashear gave a lecture on "The Optical and Engineering Problems Associated in the Construction of Great Telescopes," illustrated with lantern views, showing, among other pictures, Galileo's old observatory and some modern observatories, including that at Allegheny. The difficulties in the way of making optical glass was set forth, and the growth of the telescope was briefly reviewed from the time of the Chinese of 2,000 or 3,000 years ago, with whose crude appliances the Orientals obtained results which astronomers since have not needed to correct, down to the great telescopes of the Paris, Lick, and Chicago observatories, with their convenient and easy adjustments. On the evening of Feb. 22 the chemical section of the society held a meeting, at which Dr. E. S. Johnson, Chemist of the Black Diamond Steel Works, read a paper on "The Chemical Institute of the Heidelberg University." D. Carhart, Secy.

WESTERN RAILWAY CLUB.—At the meeting on Feb. 19 a paper was read by Mr. George Gibbs, Mechanical Engineer of the Chicago, Milwaukee & St. Paul Ry., entitled "Notes on Modern Practice in Signaling." An abstract is given in another column. The committee on revision of the Interchange Rules, Messrs. J. N. Barr, G. W. Rhodes, C. A. Schroyer, P. H. Peck, and A. M. Waitt, presented a report recommending that car owners shall be charged for the repairs of their own cars with the following exceptions:

(a) Damage caused by derailment, wreck, train parting, collision, fire, or evident carelessness in handling car shall not be chargeable to owners.

(b) Damage to draft-rigging or car sills where the amount of the damage is such as to indicate that it was due to the rough handling of the car, according to a detailed schedule set forth.

(c) In the case of damage to longitudinal sills, bill shall not be rendered for more than two sills.

(d) No bill shall be rendered for more than two end or two corner posts on same end, or for more than one end or one corner post.

(e) Any damage caused by cornering or raking cars to be assumed by the company so damaging the car.

(f) In replacing brakeshoes no labor shall be charged and no credit for scrap.

(g) Journal bearings needing renewal, no charge to be made for labor of renewing, and an arbitrary scrap credit shall be allowed for one-half the weight of the bearing applied.

(h) If repairs chargeable to owners exceed $5.00, notice descriptive of the same shall be sent at once to the owner of the car, and no bill shall be rendered for less than 25 cts.

The committee believes that with the alterations as indicated above roads will not be asked to pay for repairs to their own cars which have been caused by unduly rough handling.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on Feb. 20, Mr. J. H. Curtis read a paper on his system of water purification, which he described in our correspondence column in our issue of Feb. 21. Col. E. D. Meier read a translation of a paper by Prof. August Ritter, of Germany, on "The Mechanics of Soaring Flight." The paper was intended to prove mathematically that where wind currents varied in velocity, it was possible for a bird to soar or rise without doing work itself, and claimed that there was no motion of the wings, and that very delicate observations of wind velocities indicate wide fluctuations. In discussion Prof. Johnson denied absolutely the premises on which the paper was based, viz., that a bird did not move its wings or feathers, and that there were such frequent and regular fluctuations of wind velocities. He also showed that, even admitting the premises to be true, and placing actual values in the formulas, the wind velocity remaining available for supporting the bird was entirely too small for that purpose. Prof. Kinealy stated that some years ago Dr. Todd had read a paper before the Academy of Science in this city showing that the tail or pin feathers of the buzzard were articulated in a way permitting of a motion similar to sculling, and that there were well developed muscles connected with these feathers. These were found only in soaring birds, and they give the pin feathers a very rapid motion, which it was thought was capable of sustaining the bird. William H. Bryan, Secy.

ASSOCIATION OF ONTARIO LAND SURVEYORS.—At the annual meeting held in Toronto, Ont., last week the president, Mr. M. J. Butler, read the annual address, and the reports of committees were presented. The first paper was by D. D. James, on "A Handy Method of Indexing Office Information," which was followed by one on "Flood Prevention Work at Brantford," by C. C. Fairchild, and one on "The Aneroid," by O. J. Klotz. The report of the Committee on Drainage was presented by Mr. Geo. Ross, and brought out considerable discussion on the method of assessing the cost of constructing large drains under the new drainage laws. A paper was also read by Mr. A. R. Davis on a new gradient instrument for use of foremen in laying drains on farms, which consists simply of a triangle with a plumb line suspended from the apex. The report of the Committee on Topographical Surveying was presented by Mr. Willis Chipman, who also presented a paper on the eightieth meridian, pointing out that half of the province lies north of the main line of the Canadian Pacific Ry., and that the northern half is uninhabited and undeveloped. He also pointed out that there was probably a larger area of unexplored and unmapped territory in British North America than in Australia or Africa. The report of the Committee on Land Surveying was presented by Mr. T. B. Speight, and discussed at length. Papers were also read on "Coefficient of Refraction," by O. J. Klotz, and "The Cradle Theodolite," by J. M. O. Cromwell.

NEW PUBLICATIONS.

THIRD ANNUAL REPORT OF THE RAILROAD COMMISSION OF THE STATE OF TEXAS. Report for the Year 1894. Published by the Commission, Austin, Tex. 8vo; pp. 282.

Among the most interesting features of the report are the regulations respecting the issue of stocks and bonds, and the valuation of existing railway property and franchises. In 1893 an act was passed by which the power of issuing bonds, stocks and shares is put under the control of the state government, the railway company having to secure the approval of the Railway Commission, and in applying for such approval it must furnish maps, profiles, particulars of the physical condition of the road, and also details of the fi-

nancial conditions. The commission is conducting a careful examination of the several railways and making a valuation of their property. Up to the end of 1894 it had valued 5,888 miles, the valuation ranging from $6,882 to $34,326 per mile, and averaging $15,926 per mile. The total length of railways in the state is 9,138 miles. Abstracts are given of the companies' annual reports.

TRADE PUBLICATIONS.

ASPHALT ROOFING. A. E. Filley Mfg. Co., 39 Cortlandt St., New York city. Oblong, 5¾ × 9 ins.; pp. 16; illustrated.

This pamphlet deals principally with the Defiance asphalt roofing for railway cars, consisting of one, two or three layers of burlap, separated by layers of asphalt, and which may be laid on an old roof as an outside cover, or may be covered with sheathing. This roofing, with other asphalt roofing described, may also be used for freight sheds, shops, stations, etc., and the company also supplies asphalt paint for metal work and asphalt roofing cement.

EXCAVATORS AND DREDGES. James H. Lancaster, 39 Cortlandt St., New York city. 4to; pp. 12; illustrated.

This is an illustrated catalogue of hoisting machines, grapples, steam shovels, clam shell buckets, etc., and shows one of the machines used in dredging for a 36-in. water pipe laid in the Delaware River at Trenton, N. J.

TAPES. Justus Roe & Sons, Patchogue, N. Y. 8vo; pp. 16.

Various styles of linen and steel tapes are shown, fitted in cases or upon reels. Steel tape chains and link chains are also shown.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Mar. 8.	Cast iron pipe,	Everett, Mass.	Feb. 28
Mar. 8.	Highway bonds ($100,000),	Athens, O.	Feb. 14
Mar. 9.	Water-works system,	Clinton, Ky.	Feb. 21
Mar. 9.	School buildings,	Duluth, Minn.	Feb. 28
Mar. 9.	Paving,	Toronto, Ont.	Mar. 7
Mar. 9.	Sewer pipe (25,000 ft.),	Everett, Mass.	Mar. 7
Mar. 11.	Water-wks. system,	Knoxville, Ill.	Feb. 7
	Advertised, Eng. News, Feb. 7 to March 7.		
Mar. 11.	Dredg'g and remov'g ledge,	Portland, Me.	Feb. 14
	Advertised, Eng. News, Feb. 14 to Mar. 7.		
Mar. 11.	Water bonds,	Lafayette, Ind.	Feb. 14
Mar. 11.	Court house,	St. Joseph, Mich.	Feb. 14
Mar. 11.	Brick paving,	Monroe, Mich.	Feb. 21
Mar. 11.	Powder (150,000 lbs.),	Washington, D.C.	Feb. 28
Mar. 11.	Water-works system,	Coleman, Tex.	Feb. 28
Mar. 11.	Paving,	Oil City, Pa.	Mar. 7
Mar. 12.	Drains,	Mount Morris, Mich.	Feb. 14
Mar. 12.	Brick paving,	Peoria, Ill.	Feb. 14
	Advertised, Eng. News, Feb. 14 to 28.		
Mar. 12.	Pumping engine,	Dallas, Tex.	Feb. 21
	Advertised Eng. News, Feb. 21 to March 7.		
Mar. 12.	Sewers,	Peoria, Ill.	Feb. 21
Mar. 12.	Cast-iron pipe,	Toledo, O.	Feb. 21
Mar. 12.	Heating and vent'g app's,	Toledo, O.	Feb. 21
Mar. 12.	Lighthouse buildings,	Cleveland, O.	Feb. 28
	Advertised Eng. News, Feb. 28 and Mar. 7.		
Mar. 12.	Flagging sidewalks,	Brooklyn, N. Y.	Mar. 7
Mar. 12.	Heating & Vent'g plant,	Toledo, O.	Mar. 7
Mar. 12.	Gravel, etc.,	Boston	Mar. 7
Mar. 13.	Boilers (18),	Cincinnati, O.	Feb. 21
Mar. 13.	Approaches at Martinsburg,	W. Va.	Feb. 21
	Advertised Eng. News, Feb. 21 and 28.		
Mar. 13.	School buildings,	Detroit, Mich.	Feb. 28
Mar. 13.	Brick sewers,	Hoboken, N. J.	Feb. 28
Mar. 13.	Sewers,	Cleveland, O.	Feb. 28
Mar. 13.	Brick and stone paving,	Cleveland, O.	Feb. 28
Mar. 13.	Asphalt & brick pav'g,	Louisv'e, Ky.	Mar. 7
Mar. 13.	Pipe, valves, etc.,	Buffalo, N. Y.	Mar. 7
Mar. 13.	Repairing streets,	Chicago, Ill.	Mar. 7
Mar. 14.	Masonry culvert,	South Bend, Ind.	Feb. 21
	Advertised Eng. News, Feb. 21.		
Mar. 14.	Improving streets,	Marion, O.	Feb. 21
Mar. 14.	Steel conduit (60-in.),	Allegheny, Pa.	Feb. 28
Mar. 14.	Street repairs, etc.,	Buffalo, N. Y.	Feb. 28
Mar. 14.	Dredging,	Buffalo, N. Y.	Feb. 28
Mar. 14.	Jail,	Beaumont, Tex.	Mar. 7
Mar. 14.	Street lamps, etc.,	New York, N. Y.	Mar. 7
Mar. 14.	Pier work,	New York, N. Y.	Mar. 7
Mar. 14.	Asphalt & brick pav'g,	Winnipeg, Man.	Mar. 7
Mar. 14.	Sewers,	New York, N. Y.	Mar. 7
Mar. 14.	Pine block pav'g,	Galveston, Tex.	Mar. 7
Mar. 14.	Boiler for lighthouse tender,	Boston	Mar. 7
Mar. 14.	Paving,	Buffalo, N. Y.	Mar. 7
Mar. 14.	Laying water pipe (11 sts.),	Chicago	Mar. 7
Mar. 15.	Sewers (7 miles),	Bristol, Conn.	Feb. 14
	Advertised, Eng. News, Feb. 14 to Feb. 28.		
Mar. 15.	Water-works system,	Port Hope, Ont.	Feb. 14
Mar. 15.	Pipe sewers,	Hamilton, O.	Feb. 21
Mar. 15.	Pipe sewers,	Richmond, Ind.	Feb. 28
Mar. 15.	Brick walks, etc.,	Richmond, Ind.	Feb. 28
Mar. 15.	Bridge, Black River Falls,	Wis.	Mar. 7
Mar. 15.	Bridge,	Melrose, Wis.	Mar. 7
Mar. 15.	Sewer,	Avondale, O.	Mar. 7
Mar. 16.	Water-works system,	Evanston, O.	Feb. 21
Mar. 16.	Stone chapel,	Lancaster, O.	Feb. 21
Mar. 16.	Granite blocks,	Louisville, Ky.	Feb. 28
Mar. 16.	Electric motors,	Cleveland, O.	Mar. 7
Mar. 16.	Jetty work,	Portland, Ore.	Mar. 7
Mar. 16.	Sewers,	Pittsburg, Pa.	Mar. 7
Mar. 16.	Paving, etc.,	Pittsburg, Pa.	Mar. 7
Mar. 16.	Street signs,	Pittsburg, Pa.	Mar. 7
Mar. 18.	Steel bridge,	Atlanta, Ga.	Feb. 14
	Advertised, Eng. News, Feb. 14 to 28.		
Mar. 18.	Pumping engines,	Sacramento, Cal.	Feb. 21
Mar. 18.	Water bonds,	Caldwell, Idaho	Feb. 28
Mar. 18.	Electric light bonds,	Caldwell, Idaho	Feb. 28
Mar. 18.	Brick pav'g (3,600 sq. yds.),	Atlanta	Mar. 7
Mar. 18.	Cast iron pipe,	Cambridge, Mass.	Mar. 7
Mar. 18.	Pile bridges,	Seward, Neb.	Mar. 7
Mar. 18.	Bridge,	Columbus, Tex.	Mar. 7
Mar. 18.	Building,	Atlanta, Ga.	Mar. 7
Mar. 19.	Drains,	Mount Morris, Mich.	Feb. 14
Mar. 19.	Iron fence, etc.,	Riverside, O.	Feb. 21
Mar. 19.	Electric lighting,	Whitewater, Wis.	Feb. 14
Mar. 19.	County bridges,	Muscatine, Ia.	Feb. 28
Mar. 19.	Sewer,	Tallahassee, Fla.	Feb. 28
Mar. 19.	Water-works,	Muscatine, Ia.	Feb. 28
Mar. 19.	Water-works system,	Cuthbert, Ga.	Feb. 28
	Advertised, Eng. News, Mar. 7.		
Mar. 19.	Supplies for navy y'd at	Norfolk, Va.	Mar. 7
Mar. 19.	Supplies for navy y'd,	Was'gton, D. C.	Mar. 7
Mar. 19.	Supplies for navy y'd at	Brooklyn	Mar. 7
Mar. 19.	Water-works system,	Cadiz, O.	Mar. 7
Mar. 19.	Steel liberty pole,	Buffalo, N. Y.	Mar. 7
Mar. 19.	Pipe sewers (7,840 ft.),	Hamilton, O.	Mar. 7
Mar. 19.	Fire engines, hose, etc.,	Baltimore	Mar. 7
Mar. 19.	Artificial stone sidew'k,	Fern Bank, O.	Mar. 7
Mar. 20.	Water bonds,	Port Hope, Ont.	Feb. 28
Mar. 20.	Bridge bonds,	New Westminster, B. C.	Feb. 28
Mar. 20.	Subway,	Boston, Mass.	Feb. 21
	Advertised in Eng. News, Feb. 21 to Mar. 7.		
Mar. 20.	Power house, etc.,	Toledo, O.	Feb. 21
Mar. 20.	Dredging & rem'g rock,	Newport, R. I.	Feb. 21
	Advertised, Eng. News, Feb. 21 to Mar. 14.		
Mar. 20.	Paving (10 streets),	Cleveland	Feb. 21
Mar. 20.	Building at	Atlanta, Ga.	Mar. 7
Mar. 20.	Sewers,	Cleveland, O.	Mar. 7
Mar. 21.	Gravel roads,	Anderson, Ind.	Feb. 21
Mar. 21.	Electric lighting,	Meridian, Miss.	Feb. 14
	Advertised, Eng. News, Feb. 14 to Mar. 14.		
Mar. 21.	Jail,	Lawrenceville, Ill.	Mar. 7
Mar. 21.	Pipe sewers (9,000 ft.),	Westport, Mo.	Mar. 7
	Advertised, Eng. News, Mar. 7.		
Mar. 22.	Public building at	Sioux City, Ia.	Mar. 7
Mar. 23.	Dredging,	Montgomery, Ala.	Feb. 21
	Advertised Eng. News, Feb. 21 to Mar. 14.		
Mar. 23.	Cement,	Montgomery, Ala.	Feb. 21
	Advertised, Eng. News, Feb. 21 to Mar. 14.		
Mar. 23.	Canal (6½ miles)	Ottawa, Ont.	Feb. 21
Mar. 23.	Sewer bonds ($50,000),	Cleveland, O.	Feb. 28
Mar. 23.	Brick paving,	Cincinnati, O.	Feb. 28
Mar. 23.	Office building,	Pittsburg, Pa.	Mar. 7
Mar. 23.	Paving (11,400 sq. yds.),	Marion, O.	Mar 7
Mar. 25.	Water bonds,	Evanston, O.	Feb. 28
Mar. 25.	Water bonds,	Winton Place, O.	Feb. 28
Mar. 25.	Dam, etc.,	Cambridge, Mass.	Feb. 28
	Advertised Eng. News, Feb. 28 and Mar. 7.		
Mar. 25.	Water bonds,	Evanton, O.	Feb. 28
Mar. 25.	Street improvements,	Streator, Ill.	Mar. 7
Mar. 25.	Pipe sewers (88,881 ft.),	Pl'nfield, N. J.	Mar. 7
	Advertised, Eng. News, Mar. 7.		
Mar. 25.	Water bonds,	Hanover, Kan.	Mar. 7
Mar. 25.	Water-works system,	Hanover, Kan.	Mar. 7
Mar. 25.	Bridge,	Yonkers, N. Y.	Mar. 7
Mar. 26.	Street imprv. bonds,	Pleasant Ridge, O.	Feb. 28
Mar. 26.	Dredging plants,	Pittsburg, Pa.	Feb. 28
Mar. 26.	Steel bridge,	Denver, Colo.	Mar. 7
	Advertised, Eng. News, Mar. 7.		
Mar. 26.	Supplies for navy y'd,	Mare Isl., Cal.	Mar. 7
Mar. 27.	Plans for school bldg.,	Milwaukee, Wis.	Feb. 7
Mar. 27.	Smokestack, etc.,	Toledo, O.	Feb. 21
Mar. 27.	Bridge,	Toledo, O.	Feb. 28
Mar. 27.	Stone paving,	Cleveland, O.	Feb. 28
Mar. 27.	Dam, etc.,	Woonsocket, R. I.	Mar. 7
	Advertised, Eng. News, Mar. 7 to 21.		
Mar. 28.	Channel work,	New Orleans, La.	Mar. 7
Mar. 29.	Bridge bonds,	Winnipeg, Man.	Feb. 21
Mar. 29.	Elevators for pub. bldg.,	New York	Mar. 7
Mar. 30.	Water-works system,	Pawling, N. Y.	Feb. 28
	Advertised, Eng. News, Feb. 28 to Mar. 14.		
Mar. 30.	Pipe sewers (14,772 ft.),	Marion, O.	Mar. 7
Apr. 1.	Brick paving (20,000 yds.),	Newark, O.	Feb. 21
Apr. 1.	Sewer,	Keokuk, Ia.	Feb. 28
	Advertised Eng. News, Feb. 28 and Mar. 7.		
Apr. 1.	Water bonds,	Bancroft, Ia.	Feb. 28
Apr. 1.	Tunnel sewer,	Keokuk, Ia.	Feb. 28
	Advertised Eng. News, Feb. 28 and Mar. 7.		
Apr. 1.	License to cut timber,	Toronto, Ont.	Mar. 7
Apr. 1.	Granite block pav'g,	Cincinnati, O.	Mar. 7
Apr. 1.	Water-wks. supplies,	Oil City, Pa.	Mar. 7
Apr. 1.	Revetment work,	Duluth, Minn.	Mar. 7
Apr. 2.	Dredging,	Boston, Mass.	Feb. 28
	Advertised Eng. News, Feb. 28 to Mar. 21.		
Apr. 4.	Water bonds,	Norwood, O.	Mar. 7
Apr. 5.	Electric light plant at	Milwaukee, Wis.	Feb. 28
Apr. 5.	Heat'g & vent'g app't's,	St Louis	Mar. 7
Apr. 9.	Water-wks. system,	Seneca, Kan.	Mar. 7
	Advertised, Eng. News, Mar. 7.		
May 15.	Plans, etc., for bridge,	Montreal	Jan. 24
	Advertised, Eng. News, Jan. 24 and 31.		
May 20.	Water bonds,	Santa Clara, Cal.	Mar. 7
	Advertised, Eng. News, Mar. 7 to 28.		
May 23.	Water-wks. system,	Santa Clara, Cal.	Mar. 7
	Advertised, Eng. News, Mar. 7 to 28.		
No date.	Cotton mill,	Holyoke, Mass.	Feb. 28
	Advertised Eng. News, Feb. 28 and Mar. 7.		
"	Water-works franchise,	Barnesville, O.	Feb. 28
	Advertised, Eng. News, Feb. 28.		
"	Sewer pipe (30,000 ft.),	Orange, N. J.	Feb. 28
	Advertised, Eng. News, Feb. 28.		
"	Bridge,	Columbus, Miss.	Mar. 7
"	Tunnel (in Mexico),	San Francisco	Mar. 7

RAILWAYS.

East of Chicago.

BOOTHBAY HARBOR.—Press reports state that negotiations for the immediate building of the Boothbay Harbor railway, connecting Boothbay Harbor, Me., with the Maine Central system, a distance of 13 miles, are nearly completed. The projectors of the road have been successful in raising $225,000 in Boston with which to begin the work, and there is but little doubt that the scheme will be a reality.

PITTSBURG & LAKE ERIE.—Bids will soon be received, according to reports, for grading a branch of this road to Fayette City, Pa., from Belle Vernon, via the righthand bank of the Monongahela River, 2½ miles. A committee has been appointed at Fayette City to secure the right of way. The construction work will be in charge of J. A. Atwood, Engr., Beaver Falls, Pa.

QUINCY QUARRY.—The Quincy Quarry Co., Quincy, Mass., is reported as about to build a railway about 2¾ miles in length, including spurs. The road will be operated by the New York, New Haven & Hartford.

ULSTER & DELAWARE COUNTY.—J. H. Jones, Gen. Supt., Rondout, N. Y., writes us that the proposed extension to Kingston Point has been postponed.

WESTERN NEW YORK.—This company has been incorporated with a capital stock of $10,000,000, as a reorganization of the Western New York & Pennsylvania, whose property was sold at public auction on Feb. 5 under the foreclosure of a mortgage. The directors include Isaac N. Seligman, Gustav E. Kissel, David J. Seligman, Howard Mansfield and Henry A. James.

WINNIPEG & HUDSON'S BAY.—A press report from Ottawa states as follows: An important step has been taken by the government regarding the Hudson's Bay Ry., which has been hanging fire for the last 10 years. A contract has been entered into which will insure the immediate beginning of the construction of the road. The promoters intend to build at least 200 miles a year. The road has been graded and tracks have been laid for 40 miles northward from Winnipeg. Work will begin as soon as the weather will permit. The contractors are Wm. Mackenzie, Pres. Toronto St. Ry. Co., Donald S. Mann, Montreal, and James Isbester, Ottawa.

WISCASSET & QUEBEC.—The state railroad commission has accepted the first 28 miles of this narrow gage railway north from Wiscasset, Me. The road is being built to Burnham.

Southern.

AVON PARK TRANSPORTATION CO.—This company expects to commence work at once on a road from Avon Park via Pabor Lake, Frostproof, Midland and Buffalo Ford to Haines City, Fla., 40 miles. It will be a tram road temporarily, but steel rails will be put down later. Pres., Clark D. Knapp; Superintendent of Construction, J. C. Burleigh; Secy., C. C. Chollar; all of Avon Park, Fla.

HENDERSON & BREVARD.—Subcontracts are about to be let by Warren, Jenks & McNeely, of Henderson, N. C., for building this railway, 22 miles in length, according to reports.

LOUISVILLE & NASHVILLE.—Surveys are being made, according to reports, for a branch from Coosada to Prattville, Ala., 17 miles.

PLANT SYSTEM.—Savannah, Ga., papers state that a contract has been closed by the Plant system for the building of about 30 miles of railway between Thonotosassa, Fla., and Dade City, which will shorten the distance between Savannah and Tampa over the West Coast line by about 60 miles. The contractors are to begin the construction of the line at once, and it is to be ready for business by November.

Northwest.

CHICAGO & CARBONDALE.—The incorporation of this company was noted in our issue of Jan. 10. F. P. Read, Ch. Engr. Chicago, Paducah & Memph's, St. Elmo, Ill., has begun the location of the line, which is projected from Johnson City, on the C., P. & M., to Carbondale, Ill., about 20 miles, connecting at the latter place with the Chicago & Texas. The road will be built in the interest of the two connecting lines, and will give the Chicago & Texas direct connections to Chicago via the C., P. & M. and the Wabash. Construction will begin as soon as the location is completed.

MATTON.—Incorporated in Wisconsin Feb 27 to build a railway from Aniwa to Matton, 11 miles, all in Shawano county, Wis.; capital stock, $10,000; incorporators, Geo. R. Matton, E. E. Pantzer and Geo. J. Posson, of Sheboygan, Wis.

SUPERIOR, HAYWARD & SOUTHERN.—Incorporated in Wisconsin Feb. 26 to build a railway through Hayward and Sawyer counties to Superior; capital stock, $25,000; incorporators, David Dobie and C. C. Tennis, of West Superior; Malcolm Dobie, of Vancouver; Raleigh Chinn, of Chippewa Falls, and Cornelius Ring, of Minnesung.

Southwest.

CHOCTAW, OKLAHOMA & GULF.—Surveyors of this company are at work on an extension from Fort Reno, Okla., the terminus of its western division, northwest through the Cheyenne reservation, the Panhandle of Texas, and Beaver county.

GULF AND INTERSTATE.—Tracklaying has been commenced at Bolivar Point, opposite Galveston, Pres., Ed. De Normandie, Galveston, Tex.

GALVESTON, LA PORTE & HOUSTON.—This name was formally adopted by the company Feb. 18. The construction is progressing favorably, and the track is already laid to La Porte, and the grading and bridging necessary to fill the gaps are being pushed as fast as possible. C. W. Nelson, Audr., Houston, Tex.

KANSAS CITY, WATKINS & GULF.—It is reported that arrangements are being made to extend this railway. Pres., J. B. Watkins, Lawrence, Kan.

LITTLE ROCK & PACIFIC.—The contract for building the first 20 miles of this railway has been awarded to Quigley & Co., St. Louis, and the construction was commenced at Little Rock, Ark., this week. The line is projected from Little Rock, Ark., to Fort Smith, 230 miles. Pres., Gov. W. M. Fishback, Little Rock, Ark.

MISSISSIPPI VALLEY.—A press report from Arkansas City, Ark., states that a first mortgage was filed Feb. 28 given by the Mississippi Valley Ry. Co. to Viscount Grimston and John Williamson, of London, England, as trustees, for the bondholders, who are English people. The mortgage is given to secure the bondholders to the amount of $5,200,000. This amount is to be expended for building and equipping the road, which will be a standard gage and start from Arkansas City and extend through Chicot county to West Baton Rouge, and there connect with the New Orleans-Pacific. The line will be also connected with Natchez, Miss., at Vidalia, La., by steam ferry, and at Natchez with the Memphis & New Orleans and Columbus, Natchez & Jackson railways. The road will go through the parishes of East Carroll, Madison, Tensas, Concordia, Avoyelles, Point Coupee and West Baton Rouge, in Louisiana. It will be 261 miles in length, and will parallel the Mississipi River. Hiram R. Steele is president and James Rawlings, secretary. The route has been surveyed and right of way purchased.

TEXARKANA & FORT SMITH.—The names of the subcontractors for 50 miles of work on this road were given last week. It is stated that H. C. Lindsley has the contract for the line between Texarkana, Tex., and Shrevenort, La., about 75 miles, and has sublet 10 miles and will sublet the balance as soon as the engineers finish the location. W. C. Merritt has the first 15 miles north of Little River, Ark., of which about 4 miles are finished. A large force is on the balance. Monroe, Strang, Lee & Co. have 50 miles north of this and the gap from their 50 miles to Fort Smith will be let as soon as the line is permanently located, and large forces of engineers are in the field pushing the location.

LINK LINE.—An amendment to the original charter of the Trinity, Cameron & Western R. R. Co. gives the

company authority to extend its line from Trinity on the east to Belgrade on the Sabine River, and from Georgetown to Austin and Granite Mountain in Burnet county. Emzy Taylor, Pres., and M. P. Kelly, Gen. Man., are buying material for construction. On March 4 bids for the construction of the Georgetown & Granger division were opened. This will include the roadbed finished ready for rolling stock. The grading is completed, and trains are to be running between Georgetown and Granger by the middle of May. This road was noted in our issues of Feb. 7 and 28.

TEXAS CENTRAL.—Press reports from Waco, Tex., state that this company has purchased five blocks of ground at Waco, Tex., for terminal facilities, depots, shops, etc., and proposes to build an extension from Ross to Waco, 12 miles.

Rocky Mt. and Pacific.

CANADIAN PACIFIC.—It is reported that the Columbia & Kootenay will be extended north through the Slocan county in Southern British Columbia, to connect with the Nakusp & Slocan.

COLORADO, WYOMING & GREAT NORTHERN.—A press report from Grand Junction, Colo., states that W. T. Carpenter, Pres., is closing the sale of bonds to build this railway. Contracts for the engines have been awarded to the Baldwin Locomotive Works, and for other materials and equipments to responsible firms. It is expected that grading will be commenced this month. A surveying party has reached Rangely, in Rio Blanco county, and will proceed without delay to cover the 210 miles contemplated to reach a connection with the Oregon Short Line. The road will be standard gage, and will reach coal, asphalt, timber, stock, marble and agricultural districts in Northwestern Colorado, besides forming connection between the Northwest over the Oregon Short Line and the Denver & Rio Grande or Rio Grande Junction at Grand Junction. For 60 miles out from Grand Junction the survey is established, but beyond Rangely a tunnel will probably be necessary, and from there the route is indefinite.

COLUMBIA & RED MOUNTAIN.—The "Railroad Gazette" states that the surveys for that portion of this railway located in Washington are now nearly completed. The company was recently incorporated to build an extension of the Spokane Falls & Northern into the mines in the southern part of British Columbia. D. C. Corbin, Pres. Spokane Falls & Northern, has for a year or two been endeavoring to secure a charter for a road. He has now gone to Ottawa, and expects to have no difficulty in securing a Canadian charter from the Dominion Government. The portion of the road located in Washington will be about eight miles long, the line beginning at Northport, on the Columbia River, the present northern terminus of the Spokane Falls & Northern. This part of the road will be built during the coming season. No contracts have yet been given out. The line in British Columbia will make the total length of road about 20 miles.

PROSSER, SUNNYVILLE & NORTHERN.—Incorporated at Prosser, Yakima county, Wash., to build a railway from Prosser to a connection with the Great Northern; capital stock, $1,000,000; incorporators, J. G. Van Marter, jr., and Fred R. Reed.

SAN FRANCISCO & SAN JOAQUIN VALLEY.—Incorporated in California Feb. 26, to build a railway from San Francisco to Bakersfield, 350 miles; capital stock, $6,000,000, with $1,746,500 paid in; incorporators, Claus Spreckles, John D. Spreckles, W. F. Whittier and others, of San Francisco. This project was noted Feb. 21 and in previous issues.

Foreign.

NORTH MEXICAN PACIFIC.—A press report from Guaymas, Mex., states that all arrangements have been completed by this company for the construction of the road from that city to Topolobampo, and thence across the Sierra Madre Mountains to a connection with the Southern Pacific at some point in Texas. The road will build branch lines to Chihuahua and other points in Northern Mexico. The total mileage of the system will be 1,500 miles.

STREET AND ELECTRIC RAILWAYS.

ELLSWORTH, ME.—The construction of an electric road is being discussed. Geo. H. Stover, of New York, and O. A. Crockett, of Rockland, are interested.

BURLINGTON, VT.—The Military Post Ry. Co. has purchased rails and ties, and contracted with Guy Wilkinson, of Boston, for the construction of its electric road from Winooski to Essex Junction, a distance of about eight miles, two miles of which will be built by June 1. Pres., F. C. Kennedy; Treas., J. J. Flynn; Clk., F. O. Sinclair.

FALL RIVER, MASS.—It is reported that $43,000 has been subscribed towards the construction of the Fall River Street Ry. Co.'s electric road, to be three miles in length, the capital stock being $50,000. A franchise was granted March 1, and as soon as the full amount of the capital stock has been subscribed work will begin on the road, estimated to cost $15,000 a mile; permanent organization will be effected at once.

NATICK, MASS.—The Natick & Cochiuate St. Ry. Co. has been granted a charter to extend its road to Wellesley.

NEWTON, MASS.—The Newton & Waltham St. Ry. Co. has petitioned for authority to extend its electric road.

NORTH ATTLEBORO, MASS.—The selectmen have granted a franchise to E. R. Price for an electric railway. The company will operate its line over the old Attleboro, North Attleboro & Wrentham road.

PALMER, MASS.—The Palmer & Monson St. Ry. Co. has been organized, with a capital stock of $60,000.

COHOES, N. Y.—The Cohoes City Ry. Co. is considering the erection of a power house and car barns on North Mohawk St. It is reported that a contract has been awarded for 10,000 ties and 250 cedar poles.

DEXTER, N. Y.—The Dexter & Brownsville St. Ry. Co. has been incorporated, to build an electric road to connect Dexter, Brownsville and Sacketts Harbor; capital stock, $40,000. Incorporators, Byron B. Taggart, H. F. Inglehart and Geo. H. Walker, of Watertown; J. A. Lebkencher and J. Krements, of Newark, N. J.

GENEVA, N. Y.—The extension of the Geneva & Waterloo Electric Ry. to Cayuga Lake is being considered. Ch. Engr., S. G. Gans.

NIAGARA FALLS, N. Y.—White, Crosby & Co., of New York, have been awarded the contract for constructing the Buffalo & Niagara Falls Electric R. R. from Buffalo to the reservation in this city. The road will be double track all the way, with the exception of about 2½ miles, where it will have but one track. The work will probably be under the direction of O. B. Crosby, and must be completed by July 1.

NEWARK, N. J.—Press reports state that the Broadway Cable Co., of New York, the Consolidated Traction Co., of New Jersey, which includes every street railway in Essex, Hudson and Union counties, except one, and the Philadelphia Traction Co. are to be consolidated. The deal, if consummated, would make one of the largest corporations in the United States. The amount of stock represented in the roads of the three cities of New York, Philadelphia and Newark is estimated at about $200,000,000. Practically the three companies mentioned are already one, as far as the stockholders are concerned. That is, the largest stockholders in the Consolidated Traction Co. of this city are the largest stockholders in the Broadway Cable Co. and in the Philadelphia Traction Co. as well.

CARBONDALE, PA.—Bids are being received by the Lackawanna Valley Rapid Transit Co., according to reports, for 25 cars and materials for constructing 12 miles of single-track electric railway, delivery to be made April 15. John W. Aitken, Gen. Man.

KUTZTOWN, PA.—The Allentown & Reading Electric St. Ry. Co., noted last week, has been incorporated to build a road from Allentown to Reading, by way of Texas, Trexlertown and Kutztown; capital stock, $108,000; Pres., Jeremiah S. Trexler.

MEDIA, PA.—The Delaware County & Philadelphia Electric Ry. Co. is to extend its road the full length of Washington St. as soon as the weather permits. Supt., T. S. Hayward, Philadelphia.

NORRISTOWN, PA.—C. D. Hansberger, of Souderton, is interested in an electric railway, projected from Dublin to Norristown, by way of Blooming Glen, Lawndale, Souderton and Harleysville.

PITTSBURG, PA.—Plans are being completed for the construction of the Pittsburg & Mansfield Electric Ry. The work will include a tunnel 1,700 ft. in length and two bridges. The estimated cost of the road is about $1,250,000. Ch. Engr., E. K. Morse, Penn Bldg.

PHILADELPHIA, PA.—The Philadelphia Traction Co. is considering the question of extending its cable road along Market St. to the new piers of the Pennsylvania R. R. It is the intention of the company to build an elevated road from the east side of Water St. to Delaware Ave, so that the terminus will reach the second story of the Pennsylvania R. R. ferry-house.

POTTSVILLE, PA.—Press reports state that the Schuylkill Electric Ry. Co., which controls the street railways of this city, will begin this week to operate the old People's Ry. to Minersville by electricity. The new cars are 40 ft. long, and are equipped with two 50-HP. motors. On a recent trial trip these cars ran over the line in two minutes less time than trains drawn by steam locomotives. The Schuylkill Electric Ry. Co. is about to begin the construction of a power station and car barn 500 ft. long in Pottsville. The power station will be equipped with four 500-HP. Walker generators, driven by Corliss engines. During the present year this company contemplates building lines to Reading, to Tamaqua, and from Tamaqua to Lansford, and to Shamokin.

ANNAPOLIS, MD.—The directors of the Annapolis, Brighton & Bay Ridge R. R. Co. have confirmed the contract for the construction of the electric road awarded to Henry Y. Brady, Chesapeake Bank Bldg., Baltimore, as noted in our issue of Dec. 20. The entire road will cost about $30,000, work on which will begin April 1.

BALTIMORE, MD.—The Baltimore, Middle River & Sparrow's Point Ry. Co. has petitioned for authority from the county commissioners to extend its electric road on six streets in the county.

WETHEREDVILLE, MD.—The construction of an electric railway from this place to Cantonsville, a distance of three miles, is being discussed.

WASHINGTON, D. C.—Final surveys for the Washington & Great Falls Electric Ry. Co.'s road from Washington to Cabin John Bridge, have been completed, and the right of way very nearly all secured. Arrangements are now being made for immediate construction. Engr., F. H. Stier, 108 F St. N. W.

NORFOLK, VA.—It is reported that an electric railway five miles in length is soon to be constructed, and that bids for its construction will soon be received. J. A. Mottu, 26 Granby St.

ATLANTA, GA.—The Atlanta Consolidated St. Ry. Co. is making arrangements to double track its electric road from the city to the exposition grounds, and to otherwise improve the road. Gen. Supt., H. N. Hunt.

LONG BEACH, LA.—Plans are now being prepared for the construction of the Gulf Coast Electric Ry. It is probable that work will begin in about a month. Gen. Man., James B. Cable.

NASHVILLE, TENN.—The Belmont St. Ry. Co. has been incorporated to build an electric railway on several streets. Incorporators, James C. Bradford, Edgar Jones, I. T. Rhea and A. H. Robinson.

BUCYRUS, O.—The council is considering the question of granting an electric railway franchise.

CINCINNATI, O.—David Sinton has purchased the entire plant of the Mount Auburn Cable R. R. Co. for about $400,000. This road has been in the hands of a receiver for some time.

LORAIN, O.—The construction of an electric railway between this place and Cleveland is being discussed. O. C. Ringle and W. H. Lawrence, of Cleveland; J. M. Cahoon, of Dover, and Thomas Folger, of Avon Lake, are interested.

MILAN, O.—The Milan, Birmingham & Elyria Electric R. R. Co. is about to be incorporated, according to reports.

TOLEDO, O.—The Consolidated St. Ry. Co. is considering the question of extending its electric road from Manhattan to Cramer's Point and Presque Isle. Ch. Engr., W. D. Tyler.

VALPARAISO, IND.—Press reports state that a company will soon be incorporated by Chicago capitalists to build an electric railway connecting this city with Chicago. It is proposed to carry passengers to Chicago for 30 cts. and 40 cts. for the round trip. Cars will also be arranged for carrying light freight at a nominal price. The proposed line passes through Hobart and Whiting.

DETROIT, MICH.—The Citizens' St. Ry. Co. has decided to build at once a new power house for boilers of 6,000 H.P. The contracts for engines, dynamos, and boilers have been awarded. It has not yet been made known where the power house will be located. Pres., Thos. L. Johnson.

SAGINAW, MICH.—The Saginaw & Bay City Rapid Transit Co. has been granted a franchise for its electric road, work on which will commence at once.

GREEN BAY, WIS.—James H. Elmore, Frank Van Derzer, of Green Bay, and A. L. Smith, of Appleton, are interested in projected electric roads between Neenah, Menasha, Appleton and Kaukauna, with a branch from Green Bay to Fort Howard. It is expected that the franchise will be granted soon and the roads completed by summer.

WAUKESHA, WIS.—It is reported that the Waukesha Beach Electric Ry. Co. is considering the question of extending its road to Milwaukee.

SIOUX CITY, IA.—The Sioux City Rapid Transit Ry. Co., which recently purchased the elevated railway, is making arrangements to extend the surface line about a mile and put on additional cars and otherwise improve the system. A new electric power house will also be put in. Gen. Man., F. A. Call.

TACOMA, WASH.—Frank C. Ross has petitioned for a franchise for an electric railway between Seattle and Tacoma, according to press reports.

TACOMA, WASH.—The Tacoma Traction Co. is to equip its road from Puyallup Junction to Puyallup, a distance of 12 miles, with the trolley system. A power house will be erected at once. The contracts for the machinery and equipment have been awarded. The improvements will cost between $60,000 and $75,000. Gen. Man., J. P. Clarke.

HAYWARDS, CAL.—The construction of an electric railway between this place and San Jose is being discussed. A committee has been appointed to solicit subscriptions. Felix Chappelet, of Oakland, is interested.

LOS ANGELES, CAL.—O. A. Ivers, John S. Maltman and H. T. Hazard have petitioned the board of public works for a franchise for an electric railway.

GANANOQUE, ONT.—It is reported that the construction of an electric railway from this city to Kingston and Brockville is contemplated. J. M. Campbell, of Kingston, is said to be interested.

ELECTRIC LIGHT AND POWER.

NORTHFIELD, VT.—At a town meeting Feb. 26 the town voted to purchase three water-power privileges for $10,200. It is proposed to put in an electric plant at once on one of the locations, reserving the other two for future use. F. L. Howe, Village Clk.

NEW HAVEN, CONN.—The New Haven Electric Lighting Co. has petitioned for authority to increase its capital stock from $400,000 to $2,000,000, to purchase electrical property, including electric railways, in New Haven, Orange, Hamden and East Haven. Pres., Fred. A. Gilbert, Boston.

WATERTOWN, N. Y.—Nelson Burdick has been granted a franchise for an electric light plant.

PHILADELPHIA, PA.—A syndicate has purchased about 11 acres of land on Christian St., on which it is proposed to erect a power house, with engines of 2,500 HP., for the Southern Electric Light Co. Plans are being prepared, and it is expected that work will begin in about 30 days. Pres., John M. Mack.

TAMAQUA, PA.—The citizens have voted to spend $25,000 for the construction of an electric light plant.

CUTHBERT, GA.—Robt. L. Moye, Mayor, writes us that the council has deferred placing the $10,000 issue of electric light bonds voted at the time the water bonds were voted upon. The water-works will be put in now, and the electric light plant later in the year. The council is considering several applications for a franchise, and if it can make it to the advantage of the city it will grant a franchise, otherwise the city will later issue bonds and put in its own plant.

DOTHEN, ALA.—This place is desirous of granting an electric light franchise. H. A. Pearce, Mayor.

BRADNER, O.—The construction of an electric light plant half way between this place and Prairie Depot, to light both places, is being discussed.

CLEVELAND, O.—Bids are asked until March 16 for furnishing the electric motors and machinery for operating the Columbus St. double-swing bridge. J. H. Farley, Dir. Pub. Wks.

CHELSEA, MICH.—The citizens will vote at the next election on the question of constructing an electric light plant.

CHESANING, MICH.—The council received bids from about 30 firms for putting in an electric light plant and water-works system, as noted in these columns. E. I. Long, Village Pres.

GALESBURG, MICH.—The question of putting in an electric light plant will be voted on at the next election.

HOLLAND, MICH.—The citizens will vote in the spring on a proposition to issue $12,000 in bonds for improving the electric light plant.

BAYFIELD, WIS.—Geo. C. Morgan, Chicago, is preparing plans and specifications for a combined water-works and electric light plant.

NEW LISBON, WIS.—The construction of an electric light plant is being considered, and it is probable that the contract will soon be awarded, according to reports.

SHELBY, MINN.—We are informed that an electric light plant is to be established in connection with the water-works, now being constructed. The engine and electrical machinery have not yet been purchased. Engr., Geo. C. Morgan, Major Blk., Chicago.

NEBRASKA CITY, NEB.—The council has accepted plans for a municipal electric light plant, estimated to cost $18,200. Engr., E. A. Rudiger.

TACOMA, WASH.—E. H. McHenry, Ch. Engr. Northern Pacific R. R. Co., is reported as interested in the White River Water Power Co., described in our issue of last week.

NEW COMPANIES.—Cambridge City Electric Light Co., Cambridge, Ind.; $20,000.

Palestine Electric Light Co., Palestine, Tex.; $20,000; John R. Hearne.

Incandescent Light & Fuel Co., Carthage, Mo.; $25,000; S. E. Wetzel, J. L. Moore, Curtis Wright.

Knoxville Water & Electric Power Co., Knoxville, Tenn.; John Bane, S. A. Bailey, John J. Pogue.

Freeport Light & Fuel Co., Freeport, Ill.; $100,000; C. D. Knowlton, Louis Stoskopf, I. L. Robinson.

Ansonia Electrical Co., Ansonia, Conn.; $56,000; Franklin Farrel, Thomas Wallace, Jr., Franklin B. Platt.

Citizens' Electric Light & Power Co., Newark, O.; $30,000; Wm. G. Taafel, Wm. D. Fulton, Frank G. Warden.

Manhattan Electric Storage Battery Co., New York, N. Y.; $600,000; August Belmont, James H. Hoffman, Louis Stein.

Onondaga Dynamo Co., Syracuse, N. Y.; $25,000; to manufacture electrical appliances; Ella H. Eager, David Cronin, J. W. Eager.

Seneca Electric Light & Power Co., Seneca Falls, N. Y.; $100,000; Pres., Andrew G. Mercer; Secy., N. H. Wilcox; Treas., Philip Kendig.

Ontario Electric Co., Los Angeles, Cal.; $100,000, with $35,000 paid in; John Jenkins, Chicago, Ill.; David Elcoat, Ontario; Chas. W. Foote, Pomona; Fred B. Stamin, Ontario.

Franklin Electric Illuminating Co., Oyster Bay, N. Y.; $25,000; Samuel Stemson, John Graham, Sea Cliff; L. T. Duryea, Glen Cove; Frank D. White, H. F. Noyes, Brooklyn; James Tichborne, Mount Vernon.

BRIDGES.

BOSTON, MASS.—The city engineer estimates that the proposed rebuilding of the north draw of the Chelsea bridge would cost $10,000.

FALL RIVER, MASS.—Press reports state that an iron pile bridge across Westport River was carried away by an ice gorge March 1.

STAPLETON, N. Y.—The county engineer has been directed to prepare plans for the Fresh Kill bridge, which will be built of wood and iron.

YONKERS, N. Y.—Bids are asked by the council until March 25, according to press reports, for building a bridge over Troublesome Brook on the Scarsdale road.

JERSEY CITY, N. J.—It is reported probable that the county will soon build several new bridges. C. P. Smith, Supt.

NEWARK, N. J.—The state surveyors have made surveys with a view to ascertaining the cost of a new and much wider bridge across the canal at Willow Ave. and Main St.

JOHNSTOWN, PA.—Press reports state that legal steps have been taken to compel the Pennsylvania R. R. Co. to remove the famous stone bridge at this place, which caused such havoc during the great flood.

McKEESPORT, PA.—The Fifth Ave. & High St. Bridge Co. has awarded the contract for a new bridge connecting this city and Reynoldton to the Penn Bridge Co. There will be three spans, the channel span being 365 ft. long. White & Jutte have the contract for the stone work. The bridge will cost $150,000, and must be completed Aug. 1. It will be used by the Second Ave. Traction Co. Pres., Dr. C. R. Stucksiager, of McKeesport.

PITTSBURG, PA.—The Rapid Transit Bridge Co. has been incorporated to build the proposed bridge noted last week. S. P. White, Pres. Penn Bridge Co., is interested.——The plans for the new Pittsburg & Mansfield Electric Ry. call for a 1,700-ft. tunnel and two bridges, including a 750-ft. cantilever span across the Monongahela River at an elevation of 300 ft., according to local papers. Ch. Engr., E. K. Morse, Penn Bldg.

WILKES BARRE, PA.—Plans have been prepared by I. B. Hartwell for a bridge 800 ft. long across the railway tracks from Canal to Lincoln Sts., estimated to cost $58,000.

WILMINGTON, DEL.—The street department has ordered the secretary to advertise for bids for the construction of four bridges.

WILLIAMSPORT, MD.—A public meeting will be held March 11 to make a final effort for the construction of the proposed bridge across the Potomac River at this place. The bridge will probably cost $30,000, and only about $8,000 of stock has been subscribed, according to a press report.

TAMPA, FLA.—The council is considering a resolution authorizing a loan of $40,000 for a steel bridge across the Hillsboro River at Lafayette St. It is stated that the contract for the bridge has been awarded to the Florida Dredging Co.

COLUMBUS, MISS.—Bids will be received at the March term of the board of supervisors for the building of a bridge across Black Creek. J. A. Egger, Comr.

VOSBURG, MISS.—The Vosburg Bridge Co. has been organized to build a bridge across a railroad cut which divides the town. Pres., J. V. Penn; Vice-Pres., M. H. Turner; Secy. and Treas., J. L. Bufkin.

WORTHVILLE, KY.—It is stated that a $10,000 bridge will be constructed across Eagle Creek near this place to connect Owen and Carroll counties.

ASHTABULA, O.—The question of issuing $25,000 in bonds to assist the county commissioners to build a $75,000 bridge at Spring St. will be voted upon next month. A similar proposition was defeated last June by a majority of 16.

CINCINNATI, O.—The city engineer is preparing plans for a bridge about 210 ft. long and estimated to cost $22,000, over Fern St.

ATLANTA, MICH.—An effort is being made to secure an issue of $5,000 in bonds for a bridge and a dam across the river at this place.

FREELAND, MICH.—At a special election Feb. 27 the citizens voted, 226 to 71, to issue $12,000 in bonds for the purpose of building an iron bridge across the Tittabawassee River.

MURPHYSBORO, ILL.—An iron bridge 196 ft. long and 18 ft. wide, with 130 ft. of approaches, will be built to replace an old bridge on the Carbondale & Murphysboro road over Big Muddy River; bidders to supply plans. J. E. Crane, Engr. in Charge.

WAUZEKA, WIS.—The citizens of Grand and Crawford counties are endeavoring to secure a bridge across the Wisconsin River at this place.

BLACK RIVER FALLS, WIS.—Bids will be received by the county clerk until March 15 for the construction of an iron bridge across Black River at North Bend.

MELROSE, WIS.—Bids will be received by the town clerk until March 15 for building an iron bridge across the Black River in this town.

WAPELLO, IA.—Contracts have been awarded for a highway bridge 800 ft. long, four spans of 200 ft. each, over the Iowa River in Louisa county. The superstructure and shore piers of steel tubes and 100 ft. of pile approach to J. B. Jayne, of Iowa City, at $9,800, and three stone river piers on pile foundations to John A. Green, of Stone City, Ia., at $5,040. Geo. W. Wyne, of Cedar Rapids, is engineer in charge.

ST. PAUL, MINN.—A press report states that the Chicago Great Western Ry. Co. will, the coming summer, rebuild 102 bridges and culverts on its system, replacing 39 of them by permanent stone and steel structures; 47 by stone and earthworks, and 25 by wood. The cost will be $100,000. Contracts for the work will be signed in a day or two.

SEWARD, NEB.—Bids are asked until March 18 for the construction of pile bridges during the year 1895. D. C. Work, County Clk.

KANSAS CITY, MO.—The Runyon Bridge Construction Co. has been incorporated with a capital stock of $20,000; incorporators, W. Rider, L. S. Cherry, C. S. Lewis and others.

WARSAW, MO.—There is talk of organizing a company to build a toll bridge across the Osage River.

COLUMBUS, TEX.—Bids are asked until March 18 for constructing one approach span, one 75-ft. steel span with 14-ft. roadway, and one set of cylinder piers 30 ft. long for the Cummins Creek Bridge. E. J. Saudmeyer, County Judge.

GOLDTHWAITE, TEX.—The citizens of this place have offered the commissioners' court a bonus of $1,000 toward a proposed bridge across the Colorado River.

DENVER, COLO.—Bids are asked until March 26 for the construction of a single span 122-ft. steel girder deck bridge, as stated in our advertising columns. The bridge will be 100 ft. wide with a 60-ft. roadway paved with asphalt, upon masonry abutments to be constructed by the city. Ch. Engr., E. P. Martin.

BUILDINGS.

BROOKLYN, N. Y.—The dome of the city hall was destroyed by fire last week, and there is talk of adding a new story and building a new dome at a cost of about $280,000.——Plans for the Montauk Theatre have been prepared by J. B. McElfatrick & Son, 1402 Broadway, New York. The building will cost about $250,000, and will be built at once.

BUFFALO, N. Y.—A contract for the Elliott Square building, noted last week, has been awarded to F. W. Clark, of Chicago, at $1,650,000, as noted more fully on the first page of this issue.——Philip Becker & Co., wholesale grocers, are considering the question of building a handsome fireproof structure on Pearl St.

NEW YORK, N. Y.—The Siegel Construction Co. was incorporated last week with a capital stock of $1,000,000, to build a large dry goods and general store on 6th Ave., between 18th and 19th Sts. It is claimed that this will be the largest store of its kind in the world; incorporators, Adolph Lewishon, 81 Fulton St.; Gerson Seigel, 65 Worcester St.; Wm. R. Rose, and others.——Plans have been filed as follows: W. C. G. Wilson, 217 E. 94th St., 7-story brick flat, to cost $100,000; A. C. Hyde, 21 E. 45th St., 10-story brick hotel, to cost $200,000; George Finck, 145 Broadway, 7-story brick flat, to cost $225,000.

PITTSBURG, PA.—Bids are asked until March 22 for the erection of a general office building for the department of public safety. Arch., Chas. Bickel, 524 Penn Ave. J. O. Brown, Dir. Pub. Safety.

WILKES BARRE, PA.—The contract for preparing plans for a new county court house has been awarded to E. E. Myers, of Detroit, Mich. The building will cost about $400,000, and Mr. Myers is to receive 5% of the cost, according to the press reports.

ATLANTA, GA.—Bids are asked until March 20 for the construction of the building of the Plant system at the exposition. Address D. H. Elliott, Gen. Land Agt., Sanford, Fla.

ATLANTA, GA.—Bids are asked until March 18 for erecting the woman's building at the exposition grounds. Arch., Elsie Mercur, Pittsburg, Pa. Address C. A. Collier, Pres.

SEVIERVILLE, TENN.—The county court is reported as wanting plans for a $20,000 court house. Chn., A. P. Marshall.

LAWRENCEVILLE, ILL.—Bids are asked until March 21 for the erection of a new jail building and cells. Arch., J. W. Gladdis, Vincennes, Ind. J. K. White, Clk.

SPARTA, WIS.—A committee received 23 bids for constructing the new court house, the lowest being as follows: Foster & Smith, Minneapolis, $40,500; Yeager & Son, Danville, Ill., $40,593; Davis, Sorenson & Co., La Crosse, $40,984; Bonnett & Son, Whitewater, $41,200; Northern Building Co., St. Paul, $42,000.

SIOUX CITY, IA.—Bids are asked until March 22 for the stone and brick work, iron work, etc., for the superstructure of the U. S. public building in this city. Address Chas. E. Kemper, Acting Supervising Arch., Washington, D. C.

MINNEAPOLIS, MINN.—A large business block is to be erected at Sixth and Roberts Sts., by Messrs. Bowlby & Co., of this city.

ST. PAUL, MINN.—The Minnesota Capitol Commission has accepted the design of Wendell & Humphreys, of Denver, for a building estimated to cost nearly $1,500,000.

ST. JOSEPH, MO.—The St. Joseph Union Depot Co., has accepted the plans of F. J. Eckle, for a new one-story depot, 400 ft. long, and to cost $15,000. The architects who submitted plans are as follows: F. J. Eckle, W. A. Powell and G. M. Saemens, of St. Joseph; Clinton J. Warren, of Chicago; H. M. Hadley, and J. W. Perkins, of Topeka; Geo. R. Mann, of St. Louis; Gunn & Curtis and Van Brunt Howe, of Kansas City.

BEAUMONT, TEX.—Bids for a new jail will be received until March 14. The bids recently received were rejected as too high.

FLORENCE, COLO.—Plans for a $70,000 hotel at this place have been prepared by H. W. Baerresen & Son, Araphoe Bldg., Denver.

WATER-WORKS.

BANGOR, ME.—Local papers state that a new 1,000,000-gallon pumping station will probably soon be added to the works.

DEXTER, ME.—The Dexter Water Co., recently organized, is considering plans for proposed works.

WALPOLE, N. H.—The works at North Walpole have been sold by Mr. Monroe to W. P. Kinfry, P. E. Griffin, J. H. Hassett and C. J. O'Neil.

LYNDONVILLE, VT.—At a special village meeting Feb. 26 the commissioners were instructed to secure specifications and to issue $40,000 in 4% bonds for works. It is stated that plans were submitted several months ago.

MORRISVILLE, VT.—The contract to complete the new works being built by the village has been awarded to Maj. Chas. L. Woodbury, of Burlington.

BROOKFIELD, MASS.—The town has been authorized to make an additional water loan of $50,000.

CAMBRIDGE, MASS.—Bids are asked until March 18 for 112 tons of 4 to 6-in. cast iron pipe; L. M. Hastings, Cy. Engr.

PALMER, MASS.—It is reported probable that the taxpayers will soon vote on the question of purchasing the works of the Palmer Water Co., or building new works.

SOMERVILLE, MASS.—The water board has reported that new mains are needed; about 18 miles should be relaid at once.

SOUTH HADLEY, MASS.—Fire District No. 1 in this town has been authorized to take additional land for the protection of its water supply.

WOONSOCKET, R. I.—Bids are asked until March 27 for the construction of an earth dam, with masonry core wall, spillway, etc., as stated in our advertising columns. James W. Daly, Chn. Comrs.

ANSONIA, CONN.—The work of clearing the timber and brush from the site of the new reservoir of the Ansonia Water Co. has been completed, and the construction of the dam will be resumed as soon as the weather permits.

CROMWELL, CONN.—Subscription books have been opened for the $15,000 needed to put in the proposed works.

FARMINGTON, CONN.—The Farmington Water Co. has petitioned for a charter.

NORWICH, CONN.—It is stated that about 22,000 ft. of pipe will be relaid. R. S. Bartlett, Supt.

SEYMOUR, CONN.—R. S. Hicks, of Stafford Springs, and F. L. Rogers, of Bridgeport, are said to be interested in a company that has petitioned for a charter to put in works at this place.

WEST HARTFORD, CONN.—Residents of this place are endeavoring to secure an extension of the Hartford mains to supply this village.

ALBANY, N. Y.—The water board has petitioned for an appropriation of $15,000 for laying the foundation and increasing the size of the engine room, to provide for the erection of a third pumping engine.

AUBURN, N. Y.—Nelson B. Eldred has been appointed permanent receiver of the Auburn Water-Works Co.

BINGHAMTON, N. Y.—The commissioners have voted to petition the legislature for authority to issue bonds for a new reservoir, which will probably cost $200,000.

BUFFALO, N. Y.—Bids are asked until March 13 for a supply of cast iron pipe, valves, hydrants, etc. R. G. Parsons, Secy. Dept. Pub. Wks.

BUFFALO, N. Y.—At the meeting of the aldermen March 4 a resolution was introduced to instruct the board of public works to make the necessary surveys and procure expert engineering assistance for the establishment of an auxiliary pumping station at or near the foot of Porter Ave., and for a tunnel and intake pier beyond the contamination line in the river, and report with all convenient speed.

CALEDONIA, N. Y.—It is reported that a desirable supply has been obtained for the proposed works.

COEYMANS, N. Y.—J. A. Longyear, C. E., and E. B. Walker, J. A. Gaul, and others, of Kingston, are interested in a company, with a capital stock of $75,000, that proposes to put in works to supply this place and Ravena.

CORNING, N. Y.—Harry C. Heermans, Cy. Engr., has prepared plans for the reconstruction and enlargement of the works.

FORT PLAIN, N. Y.—Boyd Ehle, Engr., writes us that the contract for constructing works, as advertised in Engineering News, has been awarded to Gibney & Orendorf, Indianapolis, Ind., at $14,454; contract for furnishing the cast iron pipe to Chas. Millar & Sons, and that for hydrants and valves to the Eddy Valve Co.; total, $30,448. The itemized bids will probably be published in our issue of next week.

GRAND GORGE, N. Y.—We are informed that nothing has yet been decided upon in regard to the proposed works, and that the project may be postponed.

HIGHLAND MILLS, N. Y.—The town is considering the granting of a franchise. J. T. Hazard, Clk.

MONTGOMERY, N. Y.—W. L. McKinney, Clk., writes us that the citizens have voted 44 for and 31 against an issue of $18,000 in bonds for works; no other steps taken as yet.

MUNNSVILLE, N. Y.—The question of works is again being agitated.

PRATTSVILLE, N. Y.—There is talk of purchasing the works.

SCHENECTADY, N. Y.—The aldermen have voted to accept the act of the legislature authorizing an issue of $435,000 in bonds for an improved water supply.

ARLINGTON, N. J.—The Kearny township committee has directed the surveyor to prepare specifications and the clerk to advertise for bids for furnishing and laying 12,000 ft. of 12 and 15-in. pipe, and also for a water supply.

BORDENTOWN, N. J.—The board of health has issued a report condemning the source of water supply, stating that the stream is polluted with filth.

CAMDEN, N. J.—Geo. P. Pfieffer has submitted a proposition to the council offering to furnish a daily

supply of 20,000,000 gallons from artesian wells at $10 per 1,000,000 gallons.

GARFIELD, N. J.—The citizens are making an effort to secure works.

JERSEY CITY, N. J.—The mayor has approved the amended specifications for a new water supply, and it is stated that the contract will be awarded March 25.

PATERSON, N. J.—A special committee has visited the well system at Brooklyn, and is reported as to recommend to the council that steps be taken to secure an artesian supply of 7,500,000 gallons a day for the city.

ALLEGHENY, PA.—The mayor has recommended that a large reservoir be constructed.

MEADVILLE, PA.—W. A. Donne, Cy. Engr., writes us that the specifications for the new works call for two 1,500,000-gallon pumps, three boilers, pumping station, one 5,500,000-gallon reservoir, 22 miles of cast iron mains and 140 hydrants. It is possible that the city will purchase the present works.

OIL CITY, PA.—Bids are asked until April 1 for furnishing pipe, hydrants, etc., during the ensuing year. A. M. Breckinridge, Clk. Comrs.

PERKASIE, PA.—About 25 citizens are reported as organizing a company with a capital stock of $20,000 to put in works; supply will probably be from artesian wells. Secy., Mahlon Keller.

WILKES BARRE, PA.—The Crystal Spring Water Co. has contracted with the Morison-Jewell Filter Co. for a 4,000,000-gallon filter plant, similar to the one now being constructed for the Wilkes Barre Water Co.

SEAFORD, DEL.—It is reported that $20,000 in bonds will soon be issued for works.

PORTSMOUTH, VA.—G. H. Coleman, Supt., writes us that steps for proposed extensions will not be taken until later in the season.

CUTHBERT, GA.—Bids are asked until March 19 for constructing works, as stated in our advertising columns. Engrs., Mable & Sullivan, Gould Bldg., Atlanta; Robert L. Moye, Mayor.

APALACHICOLA, FLA.—W. B. Sheppard, Mayor, writes us that the election for works has been postponed for 60 days.

DOTHEN, ALA.—An artesian well is being sunk, and if a desirable supply is secured works will probably be put in later. H. A. Pearce is mayor.

CLEVELAND, TENN.—It is reported that the city is already receiving propositions for putting in works, with 30 or 40 hydrants. E. T. Hall, Chn. Com.

CADIZ, O.—Bids are asked until March 19 for the construction of works, including 22,776 ft. of pipe, 50 hydrants, and air-lift machinery to pump from drilled wells. W. H. Lucas, Cy. Clk.

DALTON, O.—It is reported that the works will soon be improved.

EVANSTON, O.—Bids are asked until March 16 for constructing works, and until March 25 for the purchase of $10,000 in 6% water bonds. Address Chas. A. Ewing, Engr., 36 Carlisle Bldg., Cincinnati.

LOGAN, O.—The city council is taking steps to issue $35,000 in bonds for works, for which the citizens recently voted.

NORWOOD, O.—Bids are asked until April 4 for the purchase of $15,000 in 4½% water bonds. W. E. Wichgar, Clk., 137 Walnut St., Cincinnati.

PORT CLINTON, O.—J. H. Faus, Clk., writes us that about 33 bids were received Feb 28 for constructing works, as advertised in Engineering News, including the following:

Shaw, Kendall & Co., Toledo, plant complete	$35,638
Goodrich, Neal & Co., Winchester, Ind., complete, except intake pipe	26,500
J. Conley & P. J. Crossen, Sandusky, pipe line	20,122
Sam'l I. Pope Co., Chicago, plant complete	48,230
Deane Steam Pump Co., Chicago, pumps, $2,900; boilers	2,500
Laidlaw-Dunn-Gordon Co., Cincinnati, pumps, $3,400; boilers	1,774
Ed Bertsch, Port Clinton, pumping station and stack	2,285
Hughes Steam Pump Co., Cleveland, pumps	3,200
E. C. Cook, Cleveland, pipe line complete	21,470
Snyder & Williams, Dayton, pipe, pumps and boilers, $24,000	23,500
T. C. Brooks, Jackson, Mich., pipe line complete, $18,700; pumps, $2,600; boilers, $2,200; pumping station and stack	2,250
Stillwell-Bierce & Smith-Valle Co., Dayton, pumps, $3,029; boilers	2,000
Phelps & Bixele, Cleveland, pipe line complete	18,849
Henry R. Worthington, Brooklyn, N. Y., pumps	3,475
Chandler & Taylor Co., Indianapolis, boiler	2,145
John H. McGowan Co., Cincinnati, pumps, $2,600; boilers	1,900
Thacher & Breyman, Toledo, intake pipe, cast iron, per lin. ft., laid, $4.60; wrought iron, $5.00; street, $5.15; coupling or screw joints, laid, $5.57.	

ST. MARY, O.—The council has decided not to put in works, as recently noted, but will grant a franchise.

WAUSEON, O.—A private company is reported as petitioning for a franchise, the water supply to be pumped from a well 12 ft. in diameter and about 140 ft. deep. W. J. Harper is a member of the council.

COLUMBUS, IND.—The citizens are agitating the question of new works, to cost about $35,000.

CRAWFORDSVILLE, IND.—The council is considering the purchase of the works. The city is at present paying $7,000 a year rental.

JEFFERSONVILLE, IND.—The city is reported as negotiating for the purchase of the works.

FLINT, MICH.—The council has voted to submit the question of purchasing the works to the taxpayers at the spring election.

HOLLAND, MICH.—The council has voted to submit to the voters at the spring election a proposition to issue $6,000 in bonds for extending the works.

OWOSSO, MICH.—Chas. H. Cossitt, Supt., has prepared plans for a new 1,000,000-gallon reservoir, to cost about $10,000.

SPRING LAKE, MICH.—A petition is being circulated asking the legislature to give the village authority to issue bonds for works.

CANTON, ILL.—The committee has been instructed to secure bids for a new artesian well, to be about 1,600 ft. deep, and to cost about $4,000.

CHICAGO, ILL.—Bids are asked until March 14 for laying mains in 11 streets. John McCarthy, Comr. Pub. Wks.

CHICAGO, ILL.—The Vandalia Water Co. has been incorporated, with a capital stock of $5,000, by Henry A. Gardener, Frank E. Bradley and B. M. Gulun.

ELKHART, ILL.—It is reported that this place will soon have water-works.

EMDEN, ILL.—The village authorities are reported as agitating the question of works.

GENEVA, ILL.—George J. Riplets, Clk., writes us that the reported extension of the works, noted in another paper, are incorrect, and that the work is not contemplated this year.

GRAYVILLE, ILL.—Plans for works are being prepared by Geo. C. Morgan, of Chicago; about 3½ miles of mains will be laid; supply to be pumped from the Big Wabash River to a steel tower; contracts will be let in 30 to 60 days.

MOUNT PULASKI, ILL.—We are informed that the specification will not be printed for two or three weeks. Engr., Dabney H. Maury, Jr., Peoria; Chn. Com., G. L. Shafer.

QUINCY, ILL.—The council has adopted the plans and specifications of Hiram Philips, of St. Louis, for new works, estimated to cost about $400,000.

RIVERSIDE, ILL.—About 4¼ miles of 4-in. mains will be laid this summer. Jas. D. Reynolds is village engineer.

WINONA, ILL.—The well for the new works has reached a depth of 1,340 ft. Water will be pumped to a tower. Engr., Geo. C. Morgan, Major Block, Chicago. No supplies have been purchased.

BAYFIELD, WIS.—A correspondent writes us that plans and specifications for a combined water-works and electric light plant are being prepared by George C. Morgan, of Chicago.

CASSVILLE, WIS.—The village clerk writes us that the legislature has been petitioned for authority to issue bonds for works.

CUMBERLAND, WIS.—The contracts for works, except a tower, has been awarded to Fairbanks, Morse & Co. at $6,245, and that for erecting a water tower to M. C. Burke at $3,500. The bids for the entire work were as follows; Engr., Chas. F. Loweth, St. Paul:

P. M. McDonald, Duluth, Minn	$10,000
Fairbanks, Morse & Co., St. Paul	10,345
Bernard McQuire, Hudson, Wis	10,440
Million & Young, St. Paul	10,469
O. H. Olsen & Co, Stillwater, Minn	10,500
M. C. Burke, West Superior, Wis	10,500
John H. Symon & Co., Chicago	11,228

GALESVILLE, WIS.—The plans for works estimate the cost at about $13,000, which is more than the council wishes to expend, and other plans are being discussed for securing works.

MARINETTE, WIS.—Professors Daniels and Russell, of the Wisconsin State University, at Madison, are reported to have declared the water to be contaminated with sewage and unfit for domestic use.

NEW LISBON, WIS.—The citizens are reported as in favor of works, and it is reported probable that the contract will soon be awarded.

WHITEHALL, WIS.—The citizens have voted to issue $3,000 in bonds to pay one-half the cost of constructing works, and it is stated that the contract for the construction will be awarded immediately.

COLUMBUS JUNCTION, IA.—The construction of works will be voted upon at the coming municipal election, according to reports.

MINNEAPOLIS, MINN.—F. W. Cappelen, Cy. Engr., informs us that plans are about completed for two storage reservoirs, with a capacity of about 47,000,000 gallons each; estimated cost, $1,150,000. A 30,000,000-gallon filter plant will be established in connection with these reservoirs. The plans provide for two additional reservoirs to be built when demands necessitate it, of the same capacity, to be operated in connection with them. The laying of a 24-in. submerged pipe connecting the east and west sides has recently been completed. Contractors, Rinker & Hoff, Minneapolis.

PLAINVIEW, MINN.—R. R. Damonde, Recdr., writes us that the proposition to issue bonds for works, as noted in our issue of Feb. 21, was defeated, but that the question will come up again, for the people must have water.

ST. PAUL, MINN.—Contracts for supplies have been awarded as follows: Valve boxes and service stop boxes, to the Northwestern Wheel & Foundry Co., of St. Paul; fire hydrants, South Park Foundry & Machine Co., of St. Paul; special castings, St. Paul Plow Works; hydrant cases and manhole covers, St. Paul Foundry Co.; brass goods, Western Supply Co.

HANOVER, KAN.—Bids are asked until March 25 for the construction of works and the purchase of water bonds. Engr., A. A. Richardson, of Lincoln, Neb.

HAVENSVILLE, KAN.—It is reported that the citizens will soon vote on a proposition to issue $2,500 in bonds for works.

SENECA, KAN.—Bids are asked until April 9 for the construction of works, as stated in our advertising columns. Engr., F. L. Burrell, Jas. H. Gleason, Mayor.

DESHLER, NEB.—We are informed that the secretary of the improvement association is securing estimates on the cost of materials and construction of a small plant for this city.

NEBRASKA CITY, NEB.—Plans and specifications for new works and an electric light plant have been submitted to the council by E. A. Rudiger, of this city; estimated cost of water-works, $85,000, and of an electric light plant, $18,200. An ordinance to submit a proposition to issue $90,000 in bonds to a vote of the taxpayers has passed first reading in the council.

ST. JOSEPH, MO.—The water committee is arranging with the St. Joseph Water Co. for important extensions and improvements of the works.

EL PASO, TEX.—B. S. Catlin, Cy. Clk., writes us that John B. Hawley, of Fort Worth, has been engaged to prepare plans and specifications and to superintend the construction of works, which will probably cost $150,000 to $175,000. The work will be advertised as soon as the specifications are ready.

FARMERSVILLE, TEX.—There is talk of constructing works at this place.

GOLIAD, TEX.—A committee, including W. E. Campbell and John Cole, has been appointed to solicit subscriptions for the organization of a water and electric light company at this place.

GROESBEECK, TEX.—H. E. Ellis, Mayor, writes us that the contract for blasting a bed of rock 15 × 25 × 20 ft. in the water-works reservoir has been awarded to W. P. Sturm, of Dallas, at $650.

SHERMAN, TEX.—It is stated that the mains will be extended and two new boilers purchased. Wm Tolson, Supt.

COLTON, CAL.—The contract for the extension of the works has been awarded by the city trustees to Wilcox & Rose, of Colton, at $12,646. The other bidders were the Tracy Mfg. Co., J. D. Hooker & Co., and the Consolidated Pipe Co., of Los Angeles, and Byrne & Drew, of Redlands.

SANTA CLARA, CAL.—Bids are asked until May 20 for the purchase of $60,000 of 5% water bonds, and until May 23 for the material and construction of a system of water works, as stated in our advertising columns. Engr., C. E. Moore.

DIGBY, N. S.—The council has voted to advertise for bids for the purchase of $35,000 in bonds for the construction of works, the construction of which will be commenced in the spring.

IRRIGATION.

HOLLISTER, CAL.—B. F. Gould is interested in a project for irrigating Salinas Valley, taking the water from the river near Soledad.

FLAGSTAFF, ARIZ.—Wilson Hamilton and John W. Francis are investigating the subject of irrigation.

PHOENIX, ARIZ.—It is reported that work will be commenced on the Rio Verde irrigation canal, about 100 miles in length and estimated to cost $2,000,000, some time this month and will be finished in about a year. The contract was awarded to Langdon, Linton & Co., of Minnesota, and Donald Grant & Co., of Faribault, Minn. The contract includes the construction of a reservoir covering 3,400 acres. Pres., A. C. Sheldon; Vice-Pres., A. H. Linton; Secy., J. K. Doolittle; Treas., F. D. Conkey; Supervising Engr., Donald W. Campbell.

NEW COMPANIES.—Stanislaus & San Joaquin Water Co., Modesto, Cal.; $150,000; Henry E. Simmons, of New Jersey; Chas. H. Leadbetter, A. L. Bancroft, of San Francisco; C. H. Leadbetter, Jr., of San Jose.

Frontin Ditch Co., Coolridge, Kan.; $5,000; J. A. Shanstrom, John J. Donohue, Paul Rich, F. H. Pomeroy, H. S. Crittenden, of Coolridge.

SEWERAGE.

DOVER, ME.—P. H. Coombs, of Bangor, has prepared plans for a system.

RUTLAND, VT.—The commissioners have recommended that $10,000 in bonds be issued to construct a sewer for Moon Brook. The city engineer is preparing plans for draining the portion of the city which now drains into this brook.

EXETER, N. H.—The committee, consisting of Chas. G. Gooch, W. Merrill and J. H. Brown, has recommended the construction of sewers estimated to cost $25,469

BROCKTON, MASS.—The city has been authorized to issue $250,000 additional bonds for sewers.

CLINTON, MASS.—It is proposed to appropriate $10,000 for extending the system.

EVERETT, MASS.—Bids are asked until March 9 for 25,000 ft. of 15 to 6-in. sewer pipe. E. W. Lydston, Cy. Engr.

LAWRENCE, MASS.—Arthur D. Marble, Cy. Engr., has recommended the construction of an 84-in. sewer with outlet into the Merrimack River, which will drain about 1,130 acres.

QUINCY, MASS.—The council has been considering a bill to be presented to the legislature for the construction of a system, estimated to cost about $400,000.

WOBURN, MASS.—It is reported that work will begin on the construction of a system as soon as the weather permits. Pipe for 13 miles of sewers has been purchased. The work laid out for this year will cost about $100,000.

ROCKVILLE, CONN.—T. H. McKenzie, of Southington, writes us that we were misinformed as to the letting of contracts, as stated in our issue of last week. Mr. McKenzie has been engaged by the borough to make investigations and report on sewage disposal only. The bids which were received March 1 were for making detail plans of the sewers and superintending the construction of the system. The contract has not yet been awarded.

DOLGEVILLE, N. Y.—The construction of a system is being considered by the village trustees. It is proposed that the chief engineer be instructed to prepare plans.

ITHACA, N. Y.—It is proposed to issue $150,000 in bonds for sewers and paving.

NEW YORK, N. Y.—Bids are asked by the department of public works until March 14 for altering sewers in four streets, and for constructing sewers in four streets.

TONAWANDA, N. Y.—The construction of 31,110 ft. of 24 to 6-in. pipe sewers has been recommended by the commissioners.

YONKERS, N. Y.—John Madigan has been awarded a contract for constructing a sewer in five streets at $22,888.

MONTCLAIR, N. J.—The council has voted to construct sewers in three streets.—Pasquale Cytane and Donata Fusco have been awarded contracts for constructing sewers in two streets.

PLAINFIELD, N. J.—Bids are asked until March 25 for constructing 88,881 ft. of 24 to 8-in. pipe sewers, as stated in our advertising columns. Constr. Engr., A. J. Gavett; Jas. T. McMurray, Cy. Clk.

McKEE'S ROCKS, PA.—C. F. F. McQuistion, of Butler, Pa., who has just completed the construction of sewers in Dubois, at a cost of $12,000, has prepared plans for a system for this place.

MEADVILLE, PA.—Bids have been received for building 1¼ miles of 15 to 18-in. pipe sewers, which will be constructed in the spring, and ordinances are

now before the council providing for the construction of probably two miles of additional sewers. Last year a main sewer and several laterals were built. W. A. Doane is city engineer.

PITTSBURG, PA.—Bids are asked until March 16 for constructing sewers in a large number of streets. E. M. Bigelow, Dir. Pub. Wks.

OWENSBORO, KY.—A committee is investigating the question of improving the system.

AVONDALE, O.—Bids are asked until March 15 for constructing a trunk sewer. W. E. Wynne, Corporation Clk.

CLEVELAND, O.—Bids are asked until March 20 for constructing sewers in seven streets. J. H. Farley, Dir. Pub. Wks.

CLEVELAND, O.—Our correspondent writes us that the following contracts have been awarded for constructing sewers, all the bids being unusually low: C. J. Engel, at $982; Wm. Eggers, at $1,769; Campbell Bros., at $326; H. L. Heilbron, $689; Ford P. Beers, at $390, $1,852 and $528. The total bids for two of the contracts were as follows, all the bidders being residents of Cleveland:

	Center St.	Euclid Ave.
Campbell Bros.	$1,891	$1,861
William Eggers	1,769	1,989
Kuentz & Kuentz	1,866	2,199
Petry & Co.	2,005	2,200
John Mahon	2,267	2,189
John Garry	2,429	2,229
H. P. Burnett	2,244	2,299
Ford P. Beers	2,227	1,852
Thomas Wood	2,311	2,366
H. L. Heilbron	2,336	2,095
McCarthy & Sager	2,801	2,876
John Moran	2,921	2,039
W. J. Gawne	2,812	2,327
Clements Bros. Construction Co.	2,567	2,063
A. G. Hausmann	2,756	2,487
William Lehman	2,541	2,216
A. F. Helm	3,729	2,980

William Stephen (informal).

HAMILTON, O.—Bids are asked until March 19 for constructing 7,840 ft. of 12 to 8-in. pipe sewers. J. J. McMaken, Cy. Clk.

MARION, O.—Bids are asked until March 30 for constructing about 14,772 ft. of 10 to 6-in. pipe sewers. James Williams, Cy. Clk.

INDIANAPOLIS, IND.—The board of public works has adopted resolutions for the construction of local sewers in Vermont, Blackford, California and West Sts., with branches in alleys; total length, 4,388 ft.; sizes, 26 × 39-in. brick to 8-in. pipe. Also for local sewer in alley north of Michigan St. and above streets and Indiana Ave.; total length, 4,221 ft.; sizes 42 × 28-in. brick to 6-in. pipe.

DETROIT, MICH.—The board of public works has recommended the reconstruction and extension of sewers in four streets, estimated to cost $40,000.

DETROIT, MICH.—The board of public works has been directed to advertise for bids for constructing sewers in three streets, estimated to cost $48,000.

BELVIDERE, ILL.—We are informed the city has decided to have surveys and designs made for a system of sewers, to be constructed during the coming season, and has engaged J. W. Alvord, 1140 The Rookery, Chicago, to prepare plans, estimates and reports. The separate system will probably be used, together with some form of land disposal, if possible.

RIVERSIDE, ILL.—Plans have been prepared by J. D. Reynolds, Village Engr., for about three miles of 12 and 9-in. pipe sewers.

MERRILL, WIS.—Geo. H. Benzenburg, Cy. Engr., Milwaukee, is preparing plans for a system.

CEDAR RAPIDS, IA.—It is proposed to extend the 10th Ave. sewer and complete sewers in two streets this year.

COUNCIL BLUFFS, IA.—It is proposed to construct 400 ft. of 14-ft. sewer in Indian Creek. S. L. Etuyre, Cy. Engr.

RED WING, MINN.—L. P. Wulff, Cy. Engr., informs us that the building of a sewerage system is being considered, with fair prospects of part of it being put in this year. A bill is now before the legislature which will authorize the council to pay for a system by installments. About 10 miles of sewers will be necessary.

KANSAS CITY, KAN.—The board of public works is considering the question of constructing a system in seven districts.

JEFFERSON CITY, MO.—The citizens have voted to issue $12,000 in bonds for a main sewer, which will be contracted for at once.

ST. LOUIS, MO.—Ordinances have been approved for constructing sewers in 15 streets.

ST. LOUIS, MO.—A bill is before the legislature for the construction of a sewer to drain 90 sq. miles of land, estimated to cost $9,600,000. It is proposed to spend $240,000 a year for 40 years on the construction.

WESTPORT, MO.—Bids are asked until March 21 for constructing about 9,000 ft. of 15 and 12-in. pipe sewers, as stated in our advertising columns. F. A. Robertson, Cy. Engr.——The city engineer writes us as follows: This Kansas City suburb has practically adopted the separate system of sewerage. At a meeting of the council Feb. 25 ordinances were passed for the construction of an outlet for nine districts on the east side; sewers will be constructed in each district on petition of the residents representing a majority of the frontage therein. It is believed that some 10 miles will be petitioned for and constructed this season.

FRESNO, CAL.—An election will be held April 9, when the question of issuing $40,000 in bonds for extending the system will be voted upon.

PALO ALTO, CAL.—It is reported that an election will soon be held to vote on the proposition to issue $47,360 in bonds for sewers.

GARBAGE DISPOSAL.

MANCHESTER, N. H.—The street commissioners are investigating the question of burning the garbage. The city is now paying $2,500 a year for the removal of garbage, and the city teams collect the ashes, etc. A. E. Herrick, Comr.

BRIDGEPORT, CONN.—The following bids were received for the collection of garbage: H. A. Whiting, Whitneyville, $7,500; Stephen Lewis, Stratford, $8,500; H. M. Rigney, Waterbury, $9,000 to collect and deliver for board of health, or $8,500 to collect and keep garbage. The contract will be awarded to Mr. Whiting, according to reports, but the method of garbage disposal has not yet been decided upon.

DAYTON, O.—A party of city officials has visited Atlanta, Ga., to inspect the crematory in operation in that city.

INDIANAPOLIS, IND.—The board of public works is considering a proposition to advertise for bids for a $50,000 garbage disposal plant, the present service being unsatisfactory.

DETROIT, MICH.—The city comptroller has been directed to advertise for bids for collecting and disposing of the garbage of the city.

STREETS AND ROADS.

BOSTON, MASS.—Bids are asked until March 12 for furnishing the street department with gravel and sand until Feb. 1, 1896. B. T. Wheeler, Supt.

HOLYOKE, MASS.—The committee has been directed to advertise for bids for furnishing 15,000 ft. of curbing.

NEW HAVEN, CONN.—The committee has voted to recommend an issue of bonds for paving.

ALBANY, N. Y.—The committee has recommended that a portion of Chestnut St. be paved with brick.

ALFRED, N. Y.—Bonds for $8,000 have been issued for constructing a macadamized road, between Alfred and Alfred Station.

BROOKLYN, N. Y.—Bids are asked until March 12 for flagging portions of sidewalks in 15 streets. A. T. White, Comr. Cy. Wks.

BUFFALO, N. Y.—Bids are asked until March 14 for paving portions of six streets with asphalt, brick or stone blocks. R. G. Parsons, Secy. Dept. Pub. Wks.

SYRACUSE, N. Y.—The city engineer has been directed to prepare plans for paving two streets with asphalt.

TROY, N. Y.—This city has been authorized to issue $100,000 in bonds for street improvements.

HATBORO, PA.—The Lansdale & Montgomery Turnpike Road Co. will soon be granted a charter, according to reports; directors, David Longaker, I. D. Van Forsen, C. S. Jenkins, Lansdale, and John G. Armstrong, of Montgomery Square.

OIL CITY, PA.—Bids are asked until March 11 for paving portions of two streets. H. H. Culbertson, Comptroller.

PITTSBURG, PA.—Bids are asked until March 16 for grading and paving in seven streets. E. M. Bigelow, Dir. Pub. Wks.

PITTSBURG, PA.—The Grant and Beechwood boulevards, for which bonds were voted last month, will probably be constructed this spring. They will be over 15 miles in length.

BALTIMORE, MD.—The council is considering the question of repaving Lanvale St. with asphalt blocks, estimated to cost $35,000, and the paving of several other streets with asphalt blocks and macadam.

ATLANTA, GA.—Bids are asked until March 18 for 3,600 sq. yds. of brick paving on Butler St. D. G. Wylie, Comr. Pub. Wks.——The council has passed ordinances for paving streets estimated to cost about $33,000.

LOUISVILLE, KY.—Bids are asked by the board of public works until March 13 for reconstructing portions of 19 streets with brick, granite or asphalt, estimated to cost $106,000.

CINCINNATI, O.—Bids are asked by the board of administration until April 1 for paving Vine St. with granite blocks.

CLEVELAND, O.—We are informed that contracts for grading, curbing, etc., have been awarded to the following local bidders, all at exceedingly low prices: A. L. Bixel, at $2,540; A. W. Brannan, at $1,407 and $464; John Moran, at $1,580; M. F. Bramley, at $883, $2,770, $1,722 and $1,651.

FERN BANK, O.—Bids are asked until March 19 for constructing an artificial stone sidewalk on Locust St. H. W. Woodruff, Clk.

MARION, O.—Bids are asked until March 23 for 11,400 sq. yds. of paving and 5,140 cu. yds. of grading. James Williams, Cy. Clk.

CHICAGO, ILL.—Bids are asked until March 13 for improving portions of 11 alleys and streets. John McCarthy, Comr. Pub. Wks.

ELWOOD, IND.—It is reported that about 10 miles of streets are to be paved with brick. About $250,000 is to be spent this year on municipal improvements.

INDIANAPOLIS, IND.—The board of public works has ordered plans prepared for asphalt pavement in Prospect St., from State to Auburn, 2,600 ft. by 40 ft., and in Ohio St. from Mississippi to West, 900 ft. by 40 ft. Cement walks have been ordered on the same streets.

ELKHART, ILL.—It is reported that two streets will be paved this year.

QUINCY, ILL.—The board of public works has passed ordinances for paving 25 blocks with brick.

RIVERSIDE, ILL.—It is expected that about four miles of streets will be macadamized this year. J. D. Reynolds is village engineer.

STREATOR, ILL.—Bids are asked until March 25 for improving 1,847 ft. of South Park St. W. J. Zilm, Cy. Clk.

RACINE, WIS.—The Racine Business Men's Association is discussing the question of good roads.

ST. PAUL, MINN.—The legislature has been petitioned by the citizens of Beltrami and Roseau counties for an appropriation of $5,000 to aid in the construction of a road 29 miles in length.——About 10 miles of streets are to be paved with asphalt or brick this season. It is reported that bids will soon be asked for paving about one mile with asphalt.

KANSAS CITY, MO.—The board of public works has recommended the paving of four streets with brick and gravel.

GALVESTON, TEX.—Bids are asked until March 14 for 10,000 sq. yds. of pine block paving on 25th St. W. L. Hallonquist, Cy. Engr.

VISALIA, CAL.—The council has voted to pave over five blocks, and bids will be advertised for soon; the work is not to begin before April 1.

TORONTO, ONT.—Bids are asked until March 9 for paving one street with asphalt and one with cedar blocks on concrete, both with granite toothing. Daniel Lamb, Chn.

WINNIPEG, MAN.—Bids are asked until March 14 for paving a portion of Main St. with asphalt, brick, stone or cedar blocks. J. C. Sproule, Chn. Com. on Wks.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

STREET SIGNS.—Pittsburg, Pa.—Bids are asked until March 16 for 5,000 street signs. E. M. Bigelow, Dir. Pub. Wks.

PIER WORK.—New York, N. Y.—Bids are asked by the department of docks until March 14 for repairing pier, new 15, North river.

JETTY WORK.—Portland, Ore.—Bids are asked until March 16 for extending the jetty on Siuslaw River, Ore. Capt. Thos. W. Symons, U. S. Engr. Office.

ORE CARS.—Duluth, Minn.—The Duluth, Missabe & Northern R. R. Co. is reported as receiving bids for 200 ore cars. It is possible the company will increase the order to 500 cars.

STEEL LIBERTY POLE.—Buffalo, N. Y.—Bids are asked until March 19 for the furnishing and erecting of a steel liberty pole 175 ft. high. R. G. Parsons, Secy. Dept. Pub. Wks.

REVETMENT WORK.—Duluth, Minn.—Bids are asked until April 1 for repair work to revetment at upper entrance, Portage Lake ship canals, Mich. Maj. C. B. Sears, U. S. Engr. Office.

DAM.—Warren, O.—The dam across the Mehoning River at the flour mills was swept away March 1. The dam was built in 1838, and press reports state that it may not be rebuilt.

IMPROVING CHANNEL.—New Orleans, La.—Bids are asked until March 28 for improving the channel, bay and passes of Bayou Vermilion, La. Maj. James B. Quinn, U. S. Engr. Office.

DRY DOCK.—Valparaiso, Chili.—A cable despatch states that the government has named a commission to purchase machinery and tools to be employed in the construction of a dry dock in Talcahuana.

HEATING AND VENTILATING PLANT.—Toledo, O.—Bids are asked until March 12 for steam heating, ventilating, power and hydraulic plant for the new Lucas county court house. Chas. H. Jones, Aud.

HEATING AND VENTILATING.—St. Louis, Mo.—Bids are asked until April 5 for the construction of hot-blast or fan-heating and ventilating apparatus in seven school buildings. C. L. Hammerstein, Secy. Bldg. Com.

GAS FRANCHISE.—Medford, Mass.—W. F. Cushing, Pres. Citizens' Gas Co., has petitioned for a franchise to lay pipes in this city, offering to erect a plant on the Mystic River and to sell gas for less than $1 per 1,000 cu. ft.

NAVAL SUPPLIES.—Washington, D. C.—Bids are asked until March 19 for sundry supplies for the navy yards at Norfolk, Washington and Brooklyn; and until March 26 for the navy yard at Mare Island, Cal. Edwin Stewart, Paymaster Gen., U. S. N.

ELEVATORS.—New York, N. Y.—Bids are asked until March 29 for furnishing and erecting complete two new hydraulic passenger elevators in the U. S. court house and post-office at New York. Chas E. Kemper, Acting Supervising Arch., Washington, D. C.

BOILER WORK.—Boston, Mass.—Bids are asked until March 14 for furnishing and installing complete in place, with all necessary connections and fittings, a new steam boiler and a new lined chimney for the lighthouse tender Myrtle. Maj. W. R. Livermore, U. S. Lighthouse Engr.

STREET LAMPS, POSTS, SIGNS, ETC.—New York, N. Y.—Bids are asked by the department of public works until March 14 for furnishing 200 boulevard lamps and 1,500 additional globes, 600 cast iron lamp posts, 1,500 street lamps, 6,500 glass street signs, and 2,000 tons of washed gravel.

TUNNEL.—San Francisco, Cal.—An advertisement in local papers states that a contract to run 2,500 ft. of tunnel can be had on favorable terms, with bonus for early completion; location of work, Candelaria mine, San Dimas, Durango, Mexico. Steam compressor and Ingersoll-Sargeant drills on the ground. Apply at room 134 Crocker Bldg. D. M. Burns.

NAVIGABLE CHANNEL.—Aransas Pass, Tex.—The Red Fish Bay Channel, Wharf & Dock Co. has been incorporated; capital stock, $100,000; incorporators, D. W. Woodruff, A. P. Frick, C. T. Black, S. P. Vantin, W. H. Emery, J. H. Drummond and C. A. Davies. The company is formed to construct and operate a navigable channel along and across Red Fish Bay, in Nueces county.

LICENSE TO CUT TIMBER.—Toronto, Ont.—Bids are asked until April 18 for the purchase of the license to cut the timber in the township of Lumsden, containing 36 square miles. The pine is large, and the land has never been cut over; Vermilion River runs through the township, which is seven miles from Chelmsford Station, on the Canadian Pacific Ry. Thos. McCracken, 2 Victoria St.

FIRE ENGINES, HOSE, ETC.—Baltimore, Md.—Bids are asked until March 19 for two crane-neck vertical piston, double steam fire engines, one of 750 and one of 650 gallons capacity, each to have the La France patent test tube boiler, and for one 75-ft. Hayes' extension ladder truck, also for four hose wagons, also for 3,000 ft. 2½-in. fabric hose and 3,000 ft. 2½-in. gum hose, with Gilmore's solid neck coupling. J. Alexander Preston, Pres. Fire Comrs.

PIERS, ETC.—Elizabeth, N. J.—The Elizabethport & Staten Island Ferry Co. has been incorporated by David J. Farmer, of this city; Edward P. Doyle, of Port Richmond; J. W. Mesereau and D. Howard Zeluff, of Mariner's Harbor, S. I., and Sterling Heyward, of New York; capital stock, $50,000. The new company will carry on a ferry business between this city and Port Richmond and Mariner's Harbor. The company will begin immediately to arrange for the location of the piers.

JAIL WORK.—Buffalo, N. Y.—The following bids

were received Feb. 26 for the construction of the proposed addition of 304 cells to the Erie county penitentiary: Champion Iron Works, Cleveland, O., plan A, $33,429; B, $38,374; C, $39,901; D, $44,847. Van Dorn Iron Works, Cleveland, O.—A, $50,000 (awarded contract); B, $42,500; C, $35,000. J. J. Churchyard, Buffalo—A, $62,000; B, $40,500; C, $37,000. Wagner Iron Works, Cleveland, 16 bids, ranging from $42,500 to $55,100.

PARK ENTRANCE.—Brooklyn, N. Y.—The following bids were received by the park department Feb. 27 for the construction of the new entrance to Prospect Park, the peculiar interest in the bids being a practical illustration of the effect of the cost of public work produced under the operation of the law compelling all stone used upon such work to be cut in the city:

	Stone cut in B'klyn.	cut in quarry.	Difference.
Union Granite Co. (rejected as informal)	$67,750	$49,675	$18,075
C. E. Tayntor & Co.	...	68,629	...
W. & T. Lamb	77,256	60,811	16,445
A. R. Baird	78,280	61,780	16,500
Harris & Maguire, Hallowell granite	88,609	66,457	22,153
Harris & Maguire, Clark Island granite	81,166	60,875	20,291
New England Granite Co.	82,248	52,524	29,724
White Granite Co.	76,065	67,955	8,110
Booth Brothers	83,217	60,017	23,200

CONTRACT PRICES.

PUMPING ENGINE.—Oil City, Pa.—The following bids were received Feb. 19 for a 5,000,000-gallon compound condensing horizontal crank and flywheel pumping engine, with a steam pressure of 90 lbs; A. M. Breckinridge, Olk. and Asst. Supt.:

Groshon High-Duty Pumping Engine Co., N. Y.	$21,500
Holly Mfg. Co., Lockport, N. Y.	21,000
Wilson Snyder Mfg. Co., Pittsburg	$10,705 to 17,500
Snow Steam Pump Wks., Buffalo	$17,500 and 25,500
Edward P. Allis Co., Milwaukee	$26,400 and 28,800
A. J. L. Loretz, Brooklyn, N. Y.	15,000
George F. Blake Mfg. Co., New York	22,300
Fraser & Chalmers, Chicago	$16,900 and 19,998
Barr Pumping Engine Co., Phila.	$14,230 and 15,000

SEWERS.—Muscatine, Ia.—The contract for constructing two sections of a main trunk sewer has been awarded to Adams Bros., as noted last week under Sewerage. A. W. Gates, Cy. Engr., informs us that the bids were as follows, the quantities and prices for concrete, brick masonry, earth excavation and pine lumber being the same for each section, except as noted:

Bids Received at Muscatine, Ia., Feb. 20, for Constructing a Main Trunk Sewer.

Bidder.	Section A. Brick sewer, 13 ft. 3 ins. x 19 ft., 321 ft., per ft.	Brick sewer, 4x5 ft., 35 ft., per ft.	Concrete, 10 cu. yds., per yd.	Brick masonry, 10 cu. yds., per yd.	Earth excavation, 10 cu. yds., per yd.	Pine lumber, 1,000 B. M., per M.	Pile foundation, 100 ft., per ft.	Total, A.	Section B. Br'k sew'r 13 ft. 3 ins. x 19 ft., 360 ft., total.	Bell mouth sewer, 24 ft., total.	Pile foundation, 620 ft., per ft.	Stone masonry, cu. yds., per yd.	Total, B.	Total, A & B.
Adams Bros., Zanesville, Ohio	$17.50	$4.50	$5.00	$10.00	$1.00	$20.00	$3.50	$6,147	$5,694	$975	$3.75	$5.00	$9,424	$15,571
Mall & Doan, Aurora, Ill.	20.50	7.00	4.50	8.00	.75	20.00	2.50	7,041	7,000	1,000	2.50	4.00	9,902	16,943
Rockford Construction Co., Rockford, Ill.	22.75	8.25	5.00	9.00	.75	40.00	.40	7,926	7,900	1,050	.40	6.00	9,437	17,364
Campbell & Dennis, Joliet, Ill	23.30	20.40	3.875	7.75	.50	18.00	2.80	8,403	6,924	585	2.70	2.50	9,447	17,850
James Selden, Muscatine, Ia.	22.30	7.43	3.00	6.24	[1].40	16.00	2.77	7,697	9,189	875	2.77	3.25	12,048	19,655
Dubuque Construction Co., Dubuque, Ia.	23.16	10.25	3.50	8.00	.50	20.00	4.50	8,175	7,489	1,075	4.50	2.00	11,594	19,769
Beckey, Hayde & Co., Muscatine, Ia.	23.82	6.75	3.75	6.60	.30	25.00	5.00	8,208	9,140	1,152	5.00	3.50	13,698	21,906
N. S. Young, Burlington, Ia.	23.00	9.50	4.00	[2]6.50	1.25	40.00	2.45	7,911	8,641	4,980	2.45	5.00	15,542	23,453
McGugin & Schnitger, Davenport, Ia.	29.00	14.00	5.00	10.00	1.00	24.00	5.30	10,252	9,516	1,344	5.30	4.00	14,530	24,782
Engineer's estimate	21.13	7.62	5.00	8.00	.50	20.00	2.20	7,234	6,980	1,029	2.20	4.00	9,728	16,962

[1] Section B, 50 cts. [2] Section B, $5.00.

STONE ROAD.—Beverly, N. J.—Chas. K. Van Sciver writes us that the contract for building a stone road from Vincentown to Cross Roads in Burlington county, was awarded on Feb. 13 to B. J. & J. P. Shanley, of Jersey City, at 86 cts. per sq. yd. for 10-in. telford road, the other bidders being the New Jersey Paving & Construction Co., of Trenton, and Barber & Ireland, of Philadelphia.

BRICK PAVING.—Muscatine, Ia.—A. W. Gates, Cy. Engr., writes us that contracts for about 42,000 sq. yds. of brick paving have been awarded to the Rockford Construction Co., as noted last week under Streets and Roads. The itemized bids for the work in district No. 8 were as follows, the price for paving being that for Galesburg brick (1) on a foundation of 10 ins. of gravel and 2 ins. of sand, and (2) on a foundation of 6 ins. of macadam, 3 ins. gravel and 2 ins. sand:

Bids Received at Muscatine, Ia., for Paving with Brick, in District No. 8.

Bidder.		Curbing. 5 x 24-in.	Curbing. 5 x 18-in.	Cement.	Resetting	Excavation.	Paving. 1.	Paving. 2.	Totals. 1.	Totals. 2.
Rockford Construction Co., Rockford, Ill.	Cash.	$0.49	$0.41	.....	$0.05	$0.16	$1.12	$1.23	$33,593	$36,189
	Bonds.	.51	.42	.....	.05	.165	1.15	1.265	34,555	37,269
Edwards & Walsh, Davenport, Ia.	Cash.	.49	.41	.....	.06	.20	1.12	1.27	34,114	37,854
	Bonds.	.52	.43	.....	.06	.21	1.17	1.32	35,721	39,261
Campbell & Dennis, Joliet, Ill.	Cash.	.58	.49	.....	.10	.30	1.09	1.29	35,655	40,285
	Bonds.	.595	.51	.....	.10	.31	1.125	1.33	36,786	41,624
George Kriechbaum, Burlington, Ia.	Cash.	.545	.42	.....	...	.225	1.16	1.22	35,849	37,265
	Bonds.	.56	.435	.....	...	.235	1.21	1.28	37,321	38,973
McGugin & Schnitger, Davenport, Ia.	Cash.	.53	.46	.42	.06	.21	1.22	1.29	37,063	38,915
	Bonds.	.53	.46	.42	.06	.22	1.26	1.33	38,137	39,789
G. M. Fiscus, Des Moines, Ia.	Cash.	.50	.42	.45	.10	.18	1.17	1.27	35,146	37,506
	Bonds.	.52	.44	.45	.10	.19	1.23	1.33	36,908	39,268
Adam Bros., Zanesville, O.	Cash.	.55	.45	...	.12	.19	1.17	1.31	35,764	39,068
	Bonds.	.55	.45	...	.12	.19	1.22	1.36	36,944	40,248
J. A. Riley, Omaha, Neb.	Cash.	.50	.45	.45	.12	.18	1.28	1.40	37,458	40,290
	Bonds.	.53	.47	.45	.12	.18	1.30	1.41	37,734	40,376
H. Bessler, Cedar Rapids, Ia.	Cash.	.58	.48	...	.05	.20	1.30	...	39,279	...
Beckey, Hayde & Co., Muscatine, Ia.	Cash.	.51	...	.47	.10	.20	1.32	1.43	39,508	42,090
	Bonds.	.52	...	.48	.12	.20	1.32	1.44	39,613	42,445

CAST IRON PIPE.—Boston, Mass.—The following contracts for cast iron water pipe have been awarded: To R. D. Wood & Co., 20 tons of 4-in., 250 of 6-in., 700 of 8-in., 600 of 36-in., 2,000 of 42-in., 1,050 of 48-in., and 150 tons of specials, at $21.60 per ton; total, $103,032; and 150 tons of 6-in., at $29.40; and 30 tons of 4-in., at $32.40; total, $85,382. To the Warren Foundry & Pipe Co., 60 tons of 10-in., 800 of 12-in., 900 of 36-in., 2,000 of 42-in., and 1,050 tons of 48-in. pipe, at $20.90, and 110 tons of specials, at $42 per ton; total, $98,879.

Milwaukee, Wis.—A contract for 1,000 tons of cast iron water pipe, with the privilege of increasing the contract an additional 600 tons, has been awarded to the Addyston Pipe & Steel Co., the bids per ton of 2,000 lbs., delivered in pipe yard in this city, being as follows; G. H. Benzenberg, Cy. Engr.:

	30 to 12-in.	8 & 6-in.	4-in.	3-in.
Anniston Pipe & F'dry Co.	$20.30	$20.30	$20.30	$20.50
Dennis Long & Co.	19.97	19.97	19.97	19.93
Howard-Harrison Iron Co.	21.00	21.00	23.00	25.00
Addyston Pipe & Steel Co.	19.40	19.90	19.90	20.90

WATER MAIN.—Jersey City, N. J.—The following bids were received Feb. 18 for furnishing and laying 4,780 ft. of 12-in. and 500 ft. of 6-in. cast iron water pipe in Summit Ave., Sanford Place, etc.; contract awarded to L. H. McGovern:

Bids Received at Jersey City, N. J., for Furnishing and Laying Water Pipe.

	Pipe, per ft. 12-in.	Pipe, per ft. 6-in.	Gates, each. 12-in.	Gates, each. 6-in.	Rock excav., per cu. yd.	Repav'g. Belg. blk., per sq. yd.	Telford paving, per sq. yd.	Bridge stone relaid, sq. ft.	Total.
Lawrence McGovern	$0.90	$0.59	$59.00	$29.00	$1.00	$0.50	$0.90	$0.10	$5,840
Geo. Clark	1.01	.58	20.00	35.00	2.50	.50	.50	.10	6,116
M. T. Connolly	1.01	.58	48.00	31.00	1.95	2.00	1.00	.50	6,198
P. T. Plunkett	1.07	.65	54.00	24.00	1.70	.01	.01	.01	6,315
Andrew Shaw	1.20	.60	36.00	15.40	.01	.30	.01	.40	6,340
Sheridan & Shea Co.	1.15	.85	50.00	35.00	.01	.25	.75	.06	6,529
*P. H. Flaherty, Jr., & Co.	1.25	1.00	40.00	30.00	1.00	.25	.40	.05	7,225

* Hoboken, N. J.; all others residents of Jersey City.

DREDGING.—New York, N. Y.—Lieut.-Col. G. L. Gillespie, U. S. Engineer Office, received the following bids Feb. 20 for dredging, (1) being the price per cubic yard for dredging in the Passaic River below Newark; (2), Passaic River above Newark; (3), Passaic River, removing boulders above Newark; (4), South River, N. J.; (5), Mattawan Creek; (6), Keyport Harbor; (7), Mattawan Creek and Keyport Harbor:

	1. cts.	2. $.	3. $.	4. cts.	5. cts.	6. cts.	7. cts.
Edgar M. Payn, Albany	..	1.30	5.00	34	..	..	..
Peter W. Myers, Albany	..	....	....	30	..	..	..
Newburg Dredging Co.	....	....	....	28	30	..	..
John H. Fenner	38	1.10	10.00	28	..	..	21
Thomas H. Benton	20	....	....	....	....	....	....
Elijah Brainard	32	1.25	7.90	38	51	31	31
R. G. & J. S. Packard	..	....	....	..	..	..	22
Alonzo E. Smith	28.9	.95	4.50	29	30	20	20

PIG LEAD AND LEAD PIPE.—Lawrence, Mass.—The water board has awarded a contract for 27,920 lbs. of lead pipe and 20,000 lbs. of pig lead to M. E. Austin & Co., at $1,729, the other bidders being: Treat Hardware & Supply Co., $1,789; C. F. Lynch, $1,795; Riley Bros., $1,800; F. W. Kidd, $1,832; B. Forbes, $1,845; Boston Lead Co., National Lead Co. and Wurzbacher, each $1,845.

BREAKING ROCK.—New York, N. Y.—The following bids for breaking rock in Raritan River, N. J., were received by Lieut.-Col. G. L. Gillespie, U. S. Engineer Office,, Feb. 20:

	Per ton.
Hingston & Woods, Buffalo, N. Y.	$0.74
John J. Fitzpatrick, Plattsburg, N. Y.	2.93
P. Sanford Ross, Jersey City, N. J.	.75

ASPHALT AND GRANITE PAVING.—Schenectady, N. Y.—The following bids were received Feb. 26 for 31,000 sq. yds. of asphalt paving on concrete and 16,000 sq. yds. of paving with granite blocks; four contracts: Joseph H. Clements & Co., Schenectady, sheet asphalt (from Santa Barbara, Cal.), $2.55 per sq. yd.; granite blocks, $3.30, including concrete foundation on State St.; curbing, 45 to 75 cts. per lin. ft.; catch basins, $30 (Hulett St., $25); water taps, $6.75; sewer connections, 25 cts.; lead pipe, 30 cts.; cross walks, 75 cts.; resetting old curb on Hulett St., 20 cts. Metropolitan Paving & Construction Co., sheet asphalt, $2.69; granite blocks, $2.69 and $2.98; curbing, 50 to 84 cts.; catch basins, $50; water taps, $8; sewer connections, 25 cts.; lead pipe, 35 cts.; cross walks, 87 cts.; resetting old curb, 15 cts. Northern New York Asphalt Paving Co., sheet asphalt, $2.71 to $2.75; granite blocks, $2.75 to $3.20; curbing, 50 to 90 cts.; catch basins, $55; water taps, $6; sewer connections, 20 cts.; lead pipe, 30 cts.; cross walks, 90 cts.; resetting old curb, 12 cts. Warren-Scharf Asphalt Paving Co., sheet asphalt, $2.74; granite blocks, $2.88 to $3.18; curbing, 50 to 93 cts.; catch basins, $52; water taps, $7; sewer connections, 40 cts.; lead pipe, 40 cts.; cross walks, 95 cts.; resetting old curb, 15 cts. Trinidad Asphalt Refining Co., sheet asphalt, $2.79; granite blocks, $2.79 and $3.23; curbing, 68 and 89 cts.; catch basins, $45; water taps, $6; sewer connections, 34 cts.; lead pipe, 44 cts. ;cross walks, $1; reseting old curb, 16 cts. Lewis R. Sebring, Cy. Engr., writes us that the bid of J. H. Clements & Co. was rejected as not according to the specifications, and the contract awarded to the Metropolitan Paving & Construction Co., of New York.

SEWER PIPE.—Medford, Mass.—Bids were opened March 2 for 145,000 ft. of 18 to 4-in. sewer pipe, and press reports state that, owing to a combination among the manufacturers, the city will have to pay 60% more for pipe this year than for similar pipe last year. T. Howard Barnes, Cy. Engr., writes us that the bids were as follows; contract not yet awarded: Geo. D. Goodrich, 67% discount on standard, 50% on 5 to 12-in., deep socket, and 54% on 15 and 18-in., deep socket; Perrin, Seamans & Co., same bid; W. G. Nash, same bid; D. W. Lewis, Waldo Bros., Portland Stoneware Co., and Fisk, Houns & Co., bid 67% on standard, and 59% on deep socket, all sizes. Some of the bidders offered 2% on net for cash in 10 days from shipment. The 15-in. pipe is to be 1¼ ins. thick, and the 18-in. to be 1½ ins. It is stated that W. G. Nash and Perrin, Seamans & Co. bid on the Central Sewer Pipe Co.'s pipe, and the others on pipe made by the Union Pipe Co.

BRICK PAVING, ETC.—Des Moines, Ia.—The following bids were received Feb. 23:

Brick Paving, 34,231 sq. yds.

	East 1st St.	East 6th St.	Maple St. and Penn. Ave.	East 9th St.
H. A. King	$1.55	$1.53	$1.38	$1.40
Capital City Brick & Pipe Co.	1.41	1.41	1.27	1.27
G. M. Fiscus	1.49	1.49	1.24	1.23
King & Kennedy	1.55	1.53	1.37	1.38
Des M. Brick Mfg. Co.	1.51	1.51	1.36	1.23½
Flint Brick Co.	1.53	1.53	1.28	1.34½
M. H. King	1.41	1.41¾	1.13	1.13
Iowa Brick Co.	1.49	1.49	1.23¾	1.24½
Campbell & Davis	1.48	1.48	1.24	1.24

Curbing, 23,331 lin. ft.

	Penn. Ave. and Fremont.	East 13th.	East 9th.	East 12th.	East Walnut.
Hugh Miller	$0.37½	$0.38	$0.37½	$0.37½	$0.37½
J. M. McGowan	.28½	.27¾	.27¾	.27¾	.27¾
W. M. Wright & Co.	.33¼	.35½	.33¼	.33¼	.33¼
M. Morkin	.35	.28	.35	.35	.36
John Carey	.34½	.36¾	.35¼	.35¼	.35
H. A. King	.36	.35	.34½	.34	.37
J. Harley & Co.	.34	.33	.34	.34	.33
King & Kennedy	.35	.37	.38	.38	.43
Bryan & Youngerman	.37¼	.27¼	.37¼	.37¼	.38
B. B. Rourk	.34	.39	.34	.24	.34
O'Brien & Co.	.36½	.37	.35½	.35½	.36½
Fleming & Co.	.33	.33	.33	.33	.33

Grading, 35,290 cu. yds.

	Forest Ave.	Penn. Ave., etc.	East 9th.
O. P. Herrick	$0.17⅞	$0.20¾	$0.19⅞
Switzer & Hershaw	.31	...	...
Rennett Bros.	...	.22½	.25
J. P. Nelson	.20½	.21¾	.22½
H. A. King	.17½	.15	.15½
John Harley & Co.	.18	.18	.18
Kavanugh & O'Connell	.19¾	.19¾	.23
King & Kennedy	.16¾	.15¾	.17
Fleming & Co.	.22	.23	.24
M. H. King	.14½	.14	.16¾
G. Christie	...	.16	...

SEWERS.—Erie, Pa.—The council opened bids Feb. 28 for constructing three pipe sewers, and awarded the following contracts: Sewer in Myrtle St., 330 ft., average cut 16.17 ft., to V. D. Eichenlaub, at $1.25 per ft.

for 18-in. pipe, 35 cts. for 9-in., 30 cts. for 6-in., $35 for each manhole, and $30 for each catchbasin; 22d St., 630 ft., average cut 15.41 ft., to John Thornton, at $1 per ft. for 15-in. pipe, 35 cts. for 9-in., 25 cts. for 6-in., $33 for each manhole and $25 for each catchbasin; 2d St., from Canal sewer, west, 1,050 ft., average cut 15.46 ft., to Lyle & Morton, the bids being as follows:

	—15-in.—				**		***
	Str't.	Br.	9-in.	6-in.	M.H.	C.B.	Well.
Lyle & Morton	$1.37	$1.50	$0.31	$0.31	$35	$25	$230
J. McCormick & Son	1.90	1.90	.50	.28	40	30	150
B. J. Murphy	2.00	2.00	.90	.50	50	50	30
V. D. Eichenlaub	2.10	2.25	.40	.35	35	30	200
O'Brien & Brennan	*2.70	3.00	.50	.40	45	40	140

* 15-in. straight, $2.70; 15-in. curve, $2.20.
** Prices for manholes at intersection were $47, $40, $250, $35,—respectively.
*** Well, 41 ft. deep, outlet to canal sewer.

METAL MARKET PRICES.

LEAD.—New York: 3.07 to 3.1 cts. Chicago: 2.95 to 3.05 cts. St. Louis: 2.85 to 2.95 cts.

NAILS.—Pittsburg: 90 to 92 cts. for wire, and 80 cts. for cut at mill in carload lots.

BARBED WIRE.—Pittsburg: galvanized, $1.90; plain, $1.20 to $1.25 for carloads at mill.

FOUNDRY AND PIG IRON.—New York: $10.50 to $12.50. Pittsburg: $9.75 to $10.75. Chicago: $9.50 to $10.50.

TRACK MATERIAL.—New York: angle bars, 1.1 to 1.5 cts.; spikes, 1.45 to 1.6 cts.; track bolts, 1.75 to 1.85 cts. with square, and 1.9 to 2 cts. with hexagon nuts. Chicago: angle bars, 1.2 to 1.3 cts.; spikes, 1.6 to 1.7 cts.; track bolts, 1.9 to 2 cts., with hexagon nuts.

RAILS.—New York: $22 at eastern mills and $22.75 at tidewater; old rails, $11 to $11.50 for iron, and $9.50 to $10 for steel; steel rails fit for relaying, $14; light rails, $21; girder rails, $24. Pittsburg: $22 for standard sections of 45 lbs. and over; $23 for light sections; old rails, $12 to $12.50 for iron and $10 for steel. Chicago: $23 for standard sections; $25 for light sections; old rails, $10.50 to $11 for iron, and $7 to $9 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.35 to 1.5 cts.; angles, 1.2 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.2 to 1.35 cts.; steel plates, 1.2 to 1.3 cts. for tank, 1.35 to 1.45 cts. for shell, 1.5 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 3 cts. for locomotive firebox. Pittsburg: beams, 1.2 to 1.5 cts.; channels, 1.2 to 1.5 cts.; angles, 1.05 to 1.15 cts.; tees, 1.2 to 1.25 cts.; universal mill plates, 1.05 to 1.15 cts.; steel plates, 1.1 to 1.2 cts. for tank, 1.2 to 1.25 cts. for shell, 1.25 to 1.3 cts. for flange, 1.75 to 2 cts. for ordinary firebox, and 2 to 4 cts. for locomotive firebox. Chicago: beams, 1.4 to 1.45 cts; channels, 1.4 to 1.45 cts.; angles, 1.3 to 1.35 cts.; tees, 1.65 to 1.7 cts., universal plates, 1.3 to 1.35 cts.; steel plates, 1.35 to 1.4 cts. for tank, 1.5 to 2 cts. for flange, 2 to 4.5 cts. for firebox.

INDUSTRIAL NOTES.

THE WELLS & FRENCH CO., of Chicago, Ill., has an order for 300 refrigerator cars for the Armour Packing Co.

THE PIERCE-CROUCH ENGINE CO., of New Brighton, Pa., will erect a new foundry for its gas engine work.

THE COLONIAL IRON & COAL CO., of Londonderry, N. B., proposes to move its iron works from Londonderry to Carleton.

THE MEMPHIS CAR & FOUNDRY CO., of Memphis, Tenn., has an order for tank cars for the Farrell Tank Line, of Omaha, Neb.

THE UNION CAR WORKS, of Lancaster, N. Y., has orders on hand for 500 cars, and will build an addition 126 × 360 ft. to its erecting shop.

THE DICKSON MFG. CO., of Scranton, Pa., has an order for two eight-wheel passenger engines for the Delaware, Lackawanna & Western R. R.

THE KANSAS CITY DREDGE CO. has been organized at Kansas City, Mo., with a capital stock of $10,000, by W. T. Urie, N. M. Martin and W. M. Martin.

THE STERLING STEEL WORKS, of McKeesport, Pa., is erecting a new building for rolling mills, and has a contract for heavy projectiles for the Japanese government.

THE WEIMER MACHINE CO., of Lebanon, Pa., has an order for a blowing engine with steam cylinder 96 × 60 ins. and air cylinder 50 × 60 ins., for the Rosena furnace, at New Castle, Pa.

THE LENOIR CAR CO., of Lenoir, Tenn., has orders for 400 copper-bottom coal cars, of 60,000 lbs. capacity, for the Southern R. R., and 100 similar cars for the Knoxville & Ohio R. R.

THE ENSIGN MFG. CO., of Huntington, W. Va., has an order for 700 ventilated fruit cars of 60,000 lbs. capacity, and 60 refrigerator cars of 60,000 lbs. capacity, for the Southern-Pacific Ry.

THE PITTSBURG LOCOMOTIVE WORKS, of Pittsburg, Pa., has delivered some heavy freight engines to the Alabama Great Southern Division of the Cincinnati, New Orleans & Texas Pacific Ry.

THE SHIFFLER BRIDGE CO., of Pittsburg, Pa., has the contract for two iron buildings, 360 × 110 and 360 × 105 ft., with corrugated iron sides, for the New Castle Steel & Tin Plate Co., of New Castle, Pa.

THE NEW PHILADELPHIA PIPE WORKS, at New Philadelphia, O., were destroyed by fire March 1, involving a loss of $75,000. J. B. Clow & Sons, of Chicago, are the owners, and are reported as intending to rebuild the plant.

THE BASS FOUNDRY & MACHINE CO., of Fort Wayne, Ind., has an order for two compound condensing engines of 1,000-HP. and one of 600-HP. for the new works of the New Castle Steel & Tin Plate Co., of New Castle, Pa.

THE MORDEN FROG & CROSSING CO., of Chicago, Ill., has been reorganized, owing to the retirement of Mr. W. J. Morden, on account of ill health. Pres., P. C. Houston, of Jamestown, N. Y.; Vice.-Pres. and Gen. Man., Irving T. Hart.

THE YOUNGSTOWN BRIDGE CO., of Youngstown, O., has secured the contract for the Hannah's Run Viaduct on the Cincinnati, Hamilton & Dayton R. R., and for two bridges on the Texas & Pacific Ry., including the tubular foundation work, 55 ft. in depth.

THE RED WING SEWER PIPE CO., of Red Wing, Minn., is equipping its plant with Reed oil burners, furnished by the National Supply Co., Manhattan Bldg., Chicago. This company has an output of about 900 carloads per year, and makes all sizes up to 24-in.

THE PETELER MFG. CO., of Minneapolis, Minn., has received a trial order for 20 iron ore cars of 3 tons capacity for use at the Auburn Mine, Virginia, Minn., and reports that about 1,100 of its cars are in use on the drainage canal, and that about 12,000 of its dump cars are in use. A system of portable tracks, designed specially for contractors, is being put on the market by this company.

THE AMERICAN RAILWAY ELECTRIC LIGHT CO., of New York city, has orders to equip a mail car for the U. S. government, a Wagner car on the New York Central R. R., one car for the Pullman Palace Car Co., and two cars (one for express and one for local trains), for the Baltimore & Ohio R. R. A dynamo is driven by gearing on one of the car axles, the current being passed through storage batteries sufficient to supply light for four or six hours.

THE TOLEDO BRIDGE CO., of Toledo, O., has been awarded the contract for putting in a 112-ft. swing span at St. Clair St., Toledo, and has recently shipped two heavy 105-ft. through girder spans to the Valley Ry. Co., of Canton, O. They were 105 ft. long. It also has about two-thirds of the ironwork erected for the Red Wing, Minn., highway bridge over the Mississippi River, which work is in charge of H. L. Hammond, with W. E. Schroeder as assistant.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., has the contract for the iron roof for the new machine shop of the Hudson River Water Power & Paper Co., at Mechanicsville, N. Y. The company also has a contract for the building of the new plant of the Poughkeepsie Electric Light & Power Co., of Poughkeepsie, N. Y. The engine and dynamo room will be 61 × 172 ft., and the boiler room 77 × 60 ft. The whole will be covered with the company's patent anti-condensation corrugated iron roofing.

THE GOYNE STEAM PUMP WORKS, of Ashland, Pa., reports the following orders: Duplex mining pump, 28-in. steam cylinders, 10 × 36-in. plungers, 1,500,000 gallons daily capacity, for the Richards colliery of the Union Coal Co., at Mount Carmel, Pa.; duplex mining pump, 20-in. steam cylinder, 10 × 18-in. plungers, 800,000 gallons daily capacity, for the Mount Jessup Coal Co., near Scranton, Pa.; compound condensing duplex mining pump, steam cylinders, 24 and 36 ins. diameter, 16 × 36-in. plungers, 4,300,000 gallons daily capacity, for the Scranton collieries of the Delaware, Lackawanna & Western R. R. The firm has also several smaller orders on hand.

THE BUCYRUS STEAM SHOVEL & DREDGE CO., of South Milwaukee, Wis., has recently shipped a special contractors' steam shovel to the Qualey Construction Co., for use on the Drainage Canal. Among other orders now on hand are three dredges for Dunbar & Sullivan, of Detroit, Mich., and a 2-yd. dipper dredge for Smythe & Mumford, of Pt. Pleasant, W. Va. A seagoing hopper dredge, with two drags, with a capacity of 250 cu. yds. per hour; the pumps have independent compound condensing and propelling engines, and two Scotch marine boilers 10 ft. in diameter. The boat will be 75 ft. long, 46 ft. wide. It is also building a hydraulic dredge for the American Hydraulic Dredging Co., of Philadelphia, with 20-in. pumps, driven by triple expansion marine engines of 500 HP.

THE MORGAN ENGINEERING CO., of Alliance, O., writes us as follows in regard to recent suits between it and the English firm of Fielding & Platt: An article has recently been published concerning the settlement of suits between Fielding & Platt, of England, and the Morgan Engineering Co., wherein it is said that the latter agreed to forego a verdict of $10,000 and pay $4,500 besides. It is true that we obtained such a verdict on the ground of defective machinery furnished by Fielding & Platt, but the $4,500, which was an undisputed balance of account due from us, was deducted therefrom, leaving a net verdict in our favor of $6,100. It is not true that after the argument in New York there was any prospect of the court disturbing our verdict. It was very evident that Judge Hammond, who tried the case, would support the verdict in our favor, and, knowing this to be so, the representatives of Fielding & Platt proposed a settlement, which, with modifications, we accepted. In this suit, after a long trial, the jury had found as above stated. At the same time another suit was pending by Fielding & Platt against us, wherein they claimed many thousands of dollars as royalties on what was called "Tweddell's system." The settlement was as follows: (1) Fielding & Platt had paid substantially all the costs (a large sum) in both suits to date of settlement, and this they released; (2) Fielding & Platt released us from all alleged claims for royalties, and dismissed their suits; (3) each party paid half the remaining costs, being a small amount; (4) we paid the balance of account due from us. We should not feel at liberty to state the terms of settlement but for the evident fact that the article in question emanated from the other side. It will at once be seen that the term of the settlement were entirely satisfactory to us.

NEW COMPANIES.—New England Construction Co., Jersey City, N. J., and New Haven, Conn.; $100,000, with $75,000 paid in; asphalt paving and municipal work; W. H. Gallup, Syracuse, N. Y.; Frank E. Blackwell, Astoria, N. Y.; G. W. S. Whitney, Orange, N. J.

Automatic Turntable Co., of Kansas City, Kan.; $100,000; Thomas Donald and C. L. Hogin.

Trinidad Foundry & Machine Co., Trinidad, Colo.; $10,000; John White and Nathan Bietten.

Missouri Dredge Co., Kansas City, Mo.; $10,000; W. M. Martin, W. T. Arie and N. M. Martin.

Hydro-Carbon Gas Light Co., Allegheny, Pa.; $1,000, with $100 paid in; Treas., G. W. Henderson.

National Granite Co., of New York, N. Y.; $25,000; Joseph Grant, Harry F. Morse and Joseph Leopold.

Runyon Bridge Construction Co., Kansas City, Mo.; $20,000; Walter Rider, L. S. Cherry and C. S. Lewis.

Stempel Fire Extinguisher Mfg. Co., St. Louis, Mo.; $2,000; J. P. Lowry, O. A. Stempel and C. M. Berry.

Kurtz & Buhrer Foundry Co., Chicago, Ill.; $60,000; George Kurtz, John S. Buhrer and James A. Brady.

Chicago Elevator & Mfg. Co., Chicago, Ill.; $200,000; John T. Richards, W. A. Jennings and W. S. Harbert.

Maxwood Brakeshoe Co., Chicago, Ill.; $25,000; Frank P. Stone, John C. McLachlan and Charles R. Lamen.

New York State Sewer Pipe Co., of Rochester, N. Y.; $200,000; W. H. Gorsline, Ira T. Otis and Edward W. Peck.

Pacific Asphalt Co., Chicago, Ill.; $50,000; John H. Breckinridge, Charles F. McKinley and T. Judson Green.

Masterman Car Equipment Co., Sacramento, Cal.; $500,000; W. H. Masterman, W. M. Rank and A. H. Clough.

Elmira Machine & Foundry Co., of Elmira, N. Y.; $23,000; Walter H. Steigel, James R. Reid and Charles F. Roe.

East St. Louis Rolling Stock Co., East St. Louis, Ill.; $50,000; railway cars; Henry D. Sexton and B. C. McLean.

East Oakland Contracting & Paving Co., Oakland, Cal.; $10,000; G. P. Vandercook, P. J. Peterson and C. L. White.

Vermilion Hedge & Wire Fence Co., Danville, Ill.; $150,000; John W. White, T. A. Haskins and A. M. Rushnell.

McDonald Automatic Railway Gate Co., Chicago, Ill.; $200,000; A. J. McDonald, J. F. Waters and J. L. Rodgers.

M. M. Buck Mfg. Co., St. Louis, Mo.; $250,000; railway supplies (reorganization of M. M. Buck & Co.); Secy., E. W. Handlan.

Jerome Aluminum Horseshoe & Mfg. Co., Chicago, Ill.; $400,000; Andrew Onderdonk, Charles F. Kimball and George A. Fuller.

High Island Granite Co., of Calais, Me.; $50,000; George Green, of Calais; John W. Woodward and L. A. Ward, of South Thomaston.

Anderson Double Water Column Pump Co., of Salt Lake City, Utah; $300,000; Pres., George W. Bywater; Vice.-Pres., P. Anderson; Secy., M. Pratt.

Couse Lubricator Mfg. Co., Newark, N. J.; $32,000, with $1,600 paid in; Charles Couse, A. H. Osborne and Edward W. Jackson, all of Belleville, N. J.

Guelph Pavement Co., of Guelph, Ont.; $25,000; Pres., W. J. Bell; Vice.-Pres., Col. Higinbotham; Man. Dir., John Cunningham; Secy., A. F. H. Jones.

Pero Automatic Car Oiler Co., of New York, N. Y.; $50,000; George W. Pero, Port Richmond, N. Y.; Charles Kipper, Tompkinsville, N. Y.; and John D. Sheldon, New Brighton, N. Y.

ADVERTISEMENTS.

You may save your city large sums of money by notifying the public through these columns of work projected by your city officials.

In May, 1894, the "Condensed List of Contracts Pending and Date of Opening Bids" was established in its present form as a regular feature of our Construction News. Like other new departures of Engineering News, this also has been copied, with hardly a change in wording or arrangement, by at least two of its contemporaries.

Editorial reference was recently made noting the fact that every one of 18 items in one of the departments of Engineering News was reproduced, with slight changes, in the columns of the next issue of a New York contemporary. This practice continues from week to week, and thus any reader of this journal who, for any reason, is unable to obtain a copy of Engineering News will not be kept in total ignorance of its contents if he can obtain a later issue of one of these contemporaries.

It is impossible in publishing news, at least in such quantities as we do, to authenticate each item before publication. We use every possible means consistent with the publication of items while there is news in them, to assure ourselves of their accuracy, and items in regard to which there seems to be any doubt are invariably printed as merely reports, and we have reason to believe that information given in our Construction News is reliable and satisfactory to an extent not equaled by any other paper.